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TECHNICAL BULLETIN No.23
***Estimation of weight and age of sheep
and goats***



ESGPIP

ETHIOPIA SHEEP AND GOAT PRODUCTIVITY IMPROVEMENT PROGRAM

Further information:

Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP)

Tel. +251 011 416 6962/3

Fax: +251 011 416 6965

E-mail: pvamrf_ethiopia@ethionet.et

Website: <http://www.esgpip.org>

FOREWORD

This technical bulletin titled “*Estimation of weight and age of sheep and goats*” is the 23rd in a series 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 sheep and goats in Ethiopia.

Knowing the weight and age of sheep and goats is very useful information to make appropriate management decisions. However, because of lack of accurate scales in most farms, linear dimensions of animals can be used to estimate weight. Equations correlating weight and linear measurements have been developed for some breeds. Animal age can be estimated by looking at the size, number and wear of teeth since small holder sheep and goat producers in Ethiopia rarely keep birth records. These being the major focus of this technical bulletin, other useful linear measurements are also included.

The information contained in this bulletin is useful for development agents to train farmers/pastoralists and also for other users engaged in business ventures based on sheep and goat rearing.

Desta Hamito (Prof.),
Chief of Party,
ESGPIP
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Estimation of weight and age of sheep and goats

By: Solomon Abegaz and Kassahun Awgichew

Editors: Alemu Yami, T.A. Gipson and R.C. Merkel

1. Introduction

The size and age of sheep and goats are normally related to their productivity. Larger sized animals usually produce more meat than smaller animals. Size is commonly represented by weight, though other linear measurements can be used. The size of an animal should be considered in relation to its age allowing for evaluation of growth performance used as a component in deciding which animals to buy, sell, cull or mate. Properly calibrated livestock scales are the most accurate and consistent method for determining body weight. Under farm conditions where scales and records may be absent, it may be difficult to know the weight and age of sheep and goats. Linear measurements of animals, in addition to providing body size, can be used to estimate weight. Change in dentition of sheep and goats from birth to maturity can be used to estimate age.

2. Need of measuring dimensions

The weight of a sheep or goat fluctuates as a result of management system, pregnancy, gut fill, lactation, etc.. Physical body characteristics or linear measurements are less affected by the above factors and allow for growth comparisons of different body parts at any stage or phase of growth. Measurements of various body conformations are of value in judging quantitative characteristics of meat and are also helpful in developing suitable selection criteria. Moreover, because of the relative ease in measuring linear dimensions they can be used as an indirect way to estimate weight.

3. Parts of the body of sheep and goats

It is important to know the different parts of the sheep and goat body to understand the different linear measurements described in this technical bulletins. Figure 1 presents the major parts of the body of a goat relevant to the parts referred to in this bulletin.

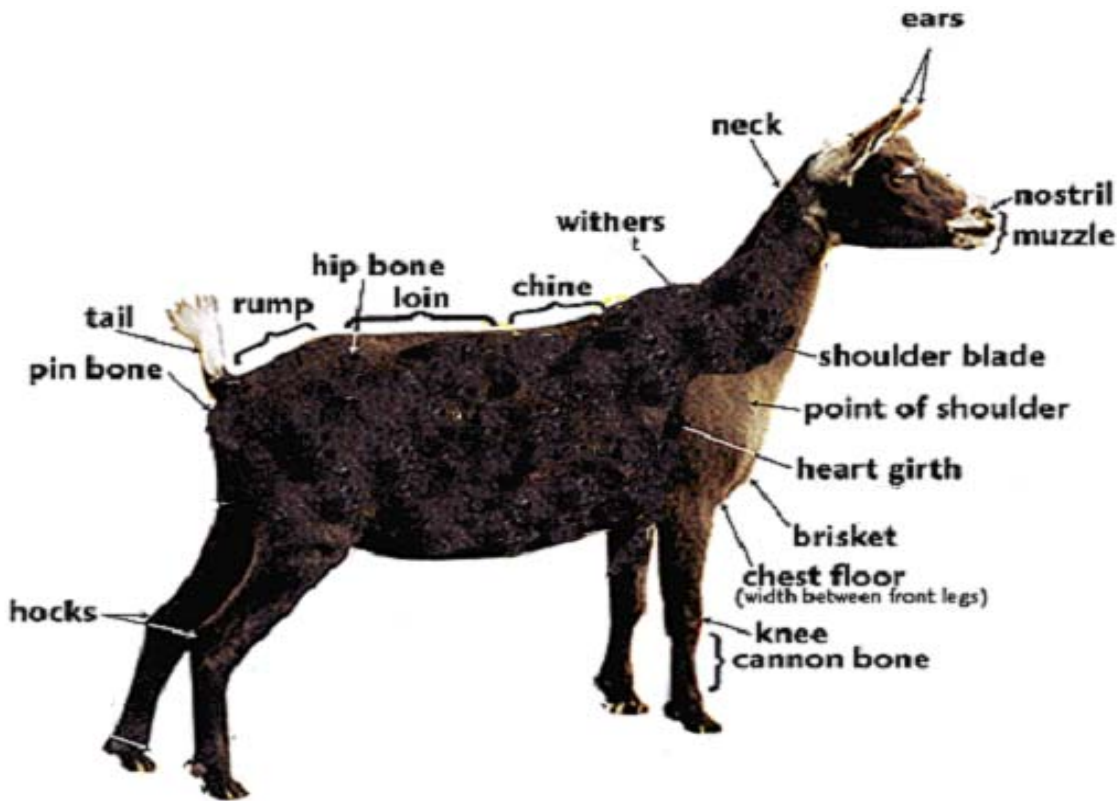


Figure 1. Body parts of a goat

4. Procedures for measuring weight

Sheep and goats are weighed for many different purposes in addition to recording growth. In countries where the sale price is based on weight, live weight has a direct relation to the profitability of the enterprise. Knowledge of animal weight is also essential for determining the dosage level of some drugs and the amount of feed to be given to the animal. Animal weight is highly prone to within individual variation due to the amount of feed and water in the gut. To minimize variation:

- Weigh at a constant time of day to obtain
 1. Fasted weight – best done in the morning before grazing or watering or
 2. Full gut weight – in the afternoon after animals have had time to eat as much as they want.

Early morning weighing is commonly practiced when animals have been locked in barns or pens overnight. This system would obviously suit Ethiopian conditions as all sheep and goats are generally housed or kraaled at night. To minimize the variation when full gut weight is taken, weigh at the same time of day each time and ensure consistent feeding and watering prior to each weighing. Additional precautions needed in weighing animals include:

- Checking the accuracy of scales against a known standard
- Avoiding human errors such as mistaken ear tag numbers or other animal identifications, mistaken weight readings, etc.

In consecutive weighings, the current weight should be compared with previous weights to note trends in live weight and guard against mistakes.

Weighing lambs and kids at birth

Birth weight is an important trait and is related to survival and growth performance. There are three main aspects to consider when measuring birth weight; Restraint, accuracy and reliability.

Restraints: Without appropriate restraint of the animals, the scale reading fluctuates wildly. This causes serious error when detecting small differences in weight. Lambs and kids can be restrained by:

- i. a plastic bucket of known weight
- ii. placing the animal in a sack
- iii. suspended by the legs
- iv. suspended in simple harness

Accuracy: Lamb birth weights commonly range from 1.5-4.0 kg and kid weights from 1.0-3.5 kg, so it is important to use a scale which has sufficient accuracy. Scales reading to 0.1 kg should be the minimum accepted.

Reliability: Clean and check the scales since the difference in birth weight to be detected is quite small. It is important to thoroughly maintain the balances/scales used.

5. Procedures for measuring linear dimensions

There are a number of linear dimensions which can be used to quantify the size of an animal and to estimate weight. Bear in mind that animal movement and body posture can introduce errors into measurements and estimated weights. Do the following to counteract these effects:

- i. When possible, choose measurements that are little affected by the animal's posture
- ii. Standardize the position of all animals that are to be compared
- iii. Be patient and wait for an animal to stand correctly.

The most widely used linear measurements include height at withers, heart girth, chest depth, body length, fore cannon bone and rump height. Heart girth and cannon bone length are least affected by the posture of the animal.

Height at withers (HAW): - This measures the distance from the surface of a platform on which the animal stands to the withers. The measurement is best made with a special measuring stick made with two arms one which is held vertical and the other at right angles to it sliding firmly up and down to record height.



Figure 2 Measurement of height at withers

The sheep or goat should stand squarely on all 4 legs. The legs should be equally spaced, and carry equal portions of its weight. Place the vertical arm of the measuring device on the ground and ensure it is at a right angle to the platform. Then slide the other shorter arm down until it just touches the shoulder at the desired point. Withdraw the vertical measuring device and measure distance with a measuring tape. Alternatively, the vertical arm could have the measuring scale inscribed onto it and height read directly (Figure 3).



Figure 3. A labeled bar being used to measure height at withers; note the graduation on the bar

Heart Girth (HG) or Chest circumference: Heart girth is a circumferential measure taken around the chest just behind the front legs and withers. The measurement should be taken to the nearest 0.5 cm. HG is a highly repeatable measure though it does vary somewhat with extremes of posture and perhaps as the animal breathes. It is the basis of the many weight tapes that are available for estimating animal weight as there is a good correlation between chest circumference and body weight, within breeds, sexes, and



Figure 4. Heart girth measurement

ages of stock. More reliable HG-live body weight relationships are obtained from mature animals. In excessively hairy sheep like the Menz sheep, make sure to compress the hair while measuring HG.

Body length (BDL):- Body length refers to the distance from the base of the ear to the base of the tail (where it joins the body). It can also be measured as the distance from base of tail to the base of the neck (first thoracic vertebrae), or to front of the chest or to tip of the nose. Extreme care is needed to ensure that the backbone is straight in both vertical and horizontal planes.

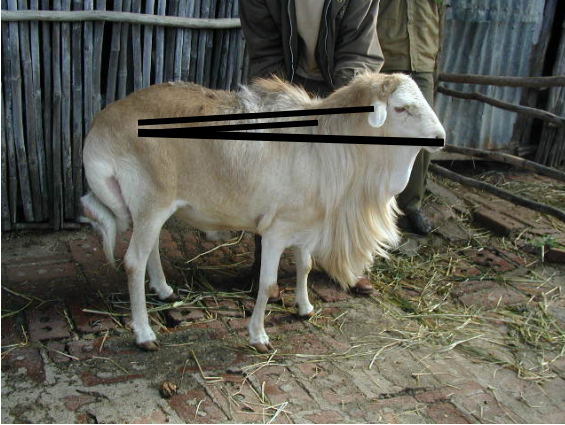


Figure 5. Body length measurement from tail base to three different points (occipital protuberance, first cervical vertebrae or tip of nose)

Hip width (pin bone width) (HW): Hip width is the distance between the outer edges of the major hip bones on the right and left side. The hipbones are easily located and the distance between them easily measured with a pair of large, half round or oval shaped calipers.

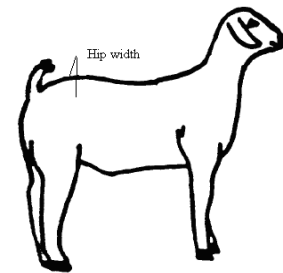


Figure 6. Measurement of hip width

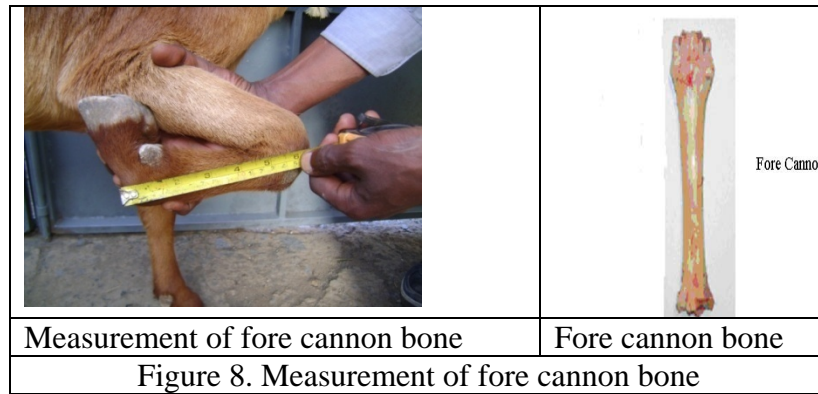
Rump height (RH):- Rump height is the distance from the surface of a platform to the rump using a measuring stick as described for height at withers..



Figure 7. Measurement of rump height

Fore cannon bone length (CB): This is the length of the lower part of the leg extending from the hock to the fetlock in hoofed mammals. It is a well-established fact that linear development of different bones in the body is strongly related. The different parts grow in proportion to one another. It should be possible to estimate the length of a bone which is difficult to measure indirectly through its correlation with a more accessible one. The fore cannon bone is the one most commonly used.

To measure fore cannon length, have the sheep or goat either stand or be held sitting on its rump. Take the front leg and bend back the hoof at the pastern and the leg itself at the knee. Use a suitable pair of large calipers, or a ruler or a measuring tape to measure the length of the main lower leg bone. For greatest accuracy, standardize your measurements using the same bony protuberances in each animal.



Chest Depth (CD): Chest depth measures the distance from the backbone at the shoulder (standardize on one of the vertical processes of the thoracic vertebrae) to the brisket between the front legs as shown in figure 9.



Figure 9. Measurement of Chest depth

6. Estimating weight from linear measurements

Increasing the genetic potential for meat production of a sheep or goat breed requires selection for increased size and live-weight. Proper size and weight measurements are often difficult in villages due to lack of weighing scales. Linear measures like heart girth are useful under these situations. Mathematical equations can be developed based on large number of actual weight-linear measurement data. The equations can be used to change linear measurements into weight estimates, usually via a constructed table (e.g. Appendix 1). Individual equations can be derived based on condition, sex and age of the animal. More than one linear measurement may be used in an equation to improve predictive ability. Examples of equations for Bonga, Horro, Afar and Menz sheep are shown in Table 1.

Table 1. Equations to estimate weight using linear measurements for different sexes and age groups of sheep.*

Breed	Sex	age	Equations**	R ²
Horro	Female	One PPI***	-46.26+0.93HG	0.50
Horro	Female	One PPI	28.15+0.62HG+0.61TC	0.61
Horro	Female	Two PPI	-21.20+0.65HG	0.49
Horro	Female	All age group	-36.13+0.86HG	0.54
Horro	Male	All age group	-39.96+1.03BL	0.81
Bonga	Female	One PPI	-17.24+0.65HG	0.45
Bonga	male	One PPI	-30.92+0.85HG	0.69
Bonga	male	One PPI	-40.53+0.69HG+0.31HAW	0.74
Bonga	Female	All age group (1-4PPI)	-33.34+0.90HG	0.62
Bonga	male	All age group	-40.95+0.99HG	0.77
Menz	Male	All age group (0 and above PPI)	-23.42+0.67HG	0.83
Menz	Female	All age group (0 and above PPI)	-23.29+0.67HG	0.80
Afar	Male	All age group (0 and above PPI)	-30.77+0.82HG	0.87
Afar	Female	All age group (0 and above PPI)	-31+0.80HG	0.78

**HG=Heart girth HAW= Height at withers BL=Body length TC=Tail circumference

*** PPI = Pair(s) of Permanent Incisors

* Source: Tesfaye Getachew. 2008. MSc Thesis, Haramaya University

Zewdu Edea. 2008. MSc Thesis, Haramaya University

Example. If we want to estimate the weight of female Bonga, Horro, Menz and Afar sheep with a heart girth measurement of 70 cm we can use the following equations:

Bonga: -33.34+0.90HG, Horro:-36.13+0.86HG, Menz:-23.29+0.67HG and –Afar: 31+0.80HG.

Table 2. Estimation of the weight of female sheep using the respective equations for the breed of

Breed	Equation	Estimated weight (Kg)
Bonga female Sheep	-33.34+0.9(70)	29.66
Horro sheep	-36.13+0.86(70)	24.07
Menz sheep	-23.29+0.67(70)	23.61
Afar sheep	-31.0+0.80(70)	25.00

A table such as the one in the Annex can be prepared and used to read the estimated weights instead of resorting to calculations for each measurement. After each measurement the tables can be read for that particular size. Another option is to prepare a weight linear measurement tape where a weight for a corresponding linear measurement can be read from the tape itself (Figure 9).



Figure 10. Weight tape

7. Importance of age determination

In addition to weight and linear dimensions knowing the age of sheep and goats is important for a number of reasons. Some of the reasons are to:

- decide when to cull
- know and choose a sheep or goat to purchase
- decide when to mate
- know contemporaries for selection among them
- adjust for age differences
- have a good estimate of (reproductive) performance of a sheep or goat

8. Determining the age of sheep and goats through dentition

Since most smallholder farmers do not keep records, it is difficult to obtain information on age of animals. Under such circumstances age is estimated based on dentition. Normal tooth arrangement in animals is, from front to back is incisors, canines, premolars, and molars. Sheep and goats, like all ruminant animals, have no canine teeth and do not have upper jaw incisors, rather they have a thick layer of tissue called the “dental pad.”

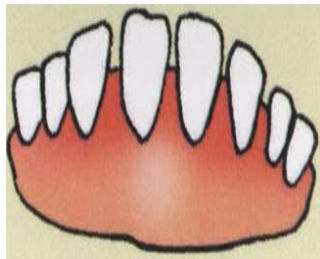
Lambs and kids start off with a set of temporary or commonly known as milk teeth. The temporary teeth are similar to the permanent teeth in form and placement but smaller in size and fewer in number. The numbers of temporary teeth are eight incisors at the front of the lower jaw and twelve molars and premolars at the back of both the upper and lower jaws.

Mature sheep and goats have a total of 8 incisors (4 pair-lower jaw), 12 premolars (lower and upper jaw, 3 pairs each), and 12 molars (lower and upper jaw, 3 pairs each) making a total of 32 teeth. When ageing sheep and goats by looking at their teeth, one considers “pairs” of incisors rather than their total. The four pairs which exist at birth or erupt after birth will be replaced by permanent incisors as the animal ages. The replacement of the incisor pairs takes place roughly every 12 months beginning with the center pair. This pattern of replacement can be used to estimate age of sheep and goats.

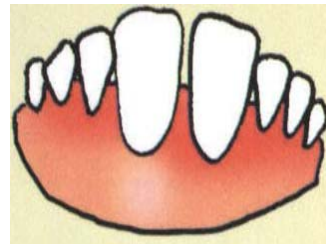
After the final pair of incisors has been replaced, the wear of the permanent teeth can give an indication of age.

Table 2. Estimated age for sheep and goats with different numbers of erupted permanent incisors

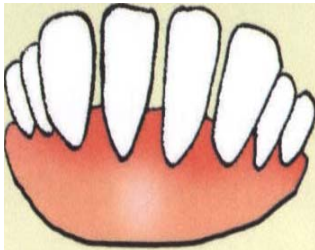
No. of permanent incisors	Estimated age range	
	Sheep	Goat
0 pair	Less than 1 year	Under 1 year
1 pair	1-1½ years	1-2 years
2 pairs	1½-2years	2-3 years
3 pairs	2½-3years	3-4 years
4 pairs	More than three years.	More than four years
Broken mouth	Aged	Aged



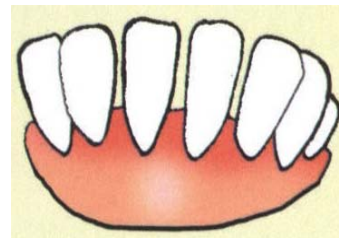
Milk teeth



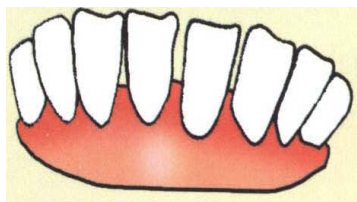
2 permanent (central) teeth



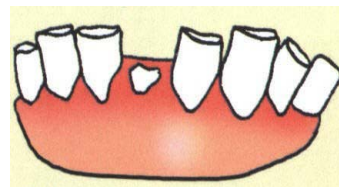
4 permanent teeth



6 permanent teeth



Full mouth – 8 permanent teeth



Broken mouth

Figure 11. Dentition showing the estimated ages of sheep and goats (Adopted from Vatta et al. 2006)

9. Summary

Sheep and goat producers would like to know the size and age of their animals for various purposes. Size is commonly measured using live weight. However, because of lack of accurate scales linear dimensions of animals can be used to estimate weight. Equations correlating weight and linear measurements have been developed for some breeds. Small holder sheep and goat producers rarely keep birth records and animal age can be estimated by looking at the size, number and wear of teeth.

What can Kebele Development Agents (KDAs) do?

- Teach and advise farmers about the importance of weight measurement and how to measure weight accurately.
- Teach and advise farmers about the importance of linear measurements, which measurements are most useful and how to accurately measure the linear dimensions.
- train farmers on the importance of age determination in the management of sheep and goats and how to use dentition to estimate age

10. References

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Appendix 1.

Relationship of Heart girth measurement with body weight of Horro sheep*

Heart girth measurement(cm)	Weight of one- year old sheep (kg)		Weight of two- year-old sheep (kg)		Weight of 3-5 year old sheep (kg)	
	Poor condition	Good condition	Poor condition	Good condition	Poor body condition	Good ** condition
60	14.30					
62	15.46					
64	16.62					
66	17.78	18.25				
68	18.94	19.63	18.62	19.67		
70	20.10	21.01	19.86	21.45	20.88	20.98
72	21.26	22.39	21.10	23.23	22.06	22.86
74	22.42	23.77	22.34	25.01	23.24	24.74
76	23.58	25.15	23.58	26.79	24.42	26.62
78	24.74	26.53	24.82	28.57	25.60	28.50
80	25.90	27.91	26.06	30.35	26.78	30.38
82	27.06	29.29	27.30	32.13	27.96	32.26
84	28.22	30.67	28.54	33.91	29.14	34.14
86	29.38	32.05	29.78	35.69	30.32	36.02
88	30.54	33.43	31.02	37.47	31.50	37.90
90	31.70	34.81	32.26	39.25	32.68	39.78
92	32.86	36.19	33.50	41.03	33.86	41.66
94	34.02	37.57	34.74	42.81	35.04	43.54
96	35.18	38.85	35.98	44.59	36.22	45.42
98	36.34	39.23	37.22	46.37	37.40	47.30
100	37.50	40.61	38.46	48.15	38.58	49.18

* Adopted from Solomon Gizaw. 1995

** Refer to ESGPIP technical Bulletin number 8 on body condition scoring.