

Husbandry Practices and Productivity Performance of Sheep under Traditional Management System in Goncha Siso Enesie District Amhara Region, Ethiopia

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Abstract
The study was conducted with the objectives of assessing husbandry practices and productivity performance of sheep under traditional management system in Goncha Siso Enesie district Amhara Region of Ethiopia. Semi structured questionnaires were used to collect data on husbandry practices, productive performance and socioeconomic aspects in 2015. One hundred eighty households with small, medium and large flock size sheep were randomly selected from six peasant associations. Mean and standard deviations of sheep flock size of the farmers was about 14.83± 10.76. Sheep hold several roles and breeding was ranked as the first purpose of keeping sheep. Disease and internal parasite incidence ranked as a major constraint followed by shortage of grazing land, breed performance, and lack of feed during dry seasons. Average age at first sexual maturity was 11.64± 0.26 and 11.14± 0.253 months for male and female, respectively. Age at first lambing ranged from 15.20 ± 0.354 to 18.37 ± 0.722 months with mean ;f 16.74± 0.249 female sheep. Lambing interval was 9.64± 0.105 months. Overall average litter size was 1.12± 0.023. Single birth was the most frequent (88.9 %) type of birth occurred in sheep of the study area. Lambing occurred most frequently between Novembers to January. Annual reproduction rate of ewes was 1.41 lambs/ewe/year. The mean flock mortality rate was 16.63 %. The total off-take rate was 37.39% per annum. Traditional sheep production systems in the study area was considered unsatisfactory in feeding and feed management practices. Poor productive and reproductive performances of indigenous sheep breed were investigated. In addition to, the strategy could focus on developing small-scale market-oriented intensive production systems depending on the characteristics of the existing production systems and agro-ecologies to achieve growth and transformation plan.
Keywords: Body weight, husbandry practice linear body measurements, productivity performances, Sheep

Introduction

Ethiopia is home for an estimated 25 million sheep with 14 type traditional sheep populations (Gizaw et al 2007). Their multipurpose role of sheep as source of income, meat, skin, manure and coarse wool or long hairy fleece, means of risk avoidance during crop failure and their cultural function during festivals are well documented (Kosgey et al 2008). Indigenous sheep breeds have great potential to contribute more to the livelihood of people in low-input, smallholder crop livestock and pastoral production systems (Kosgey and Okeyo 2007).

The reproductive performance of sheep is a trait of outstanding importance in small ruminant production which affects the overall productivity of the flock. The most important once are age at first lambing, litter size and lambing interval (Ibrahim 1998). Such traits are more related to most of the economically important traits and more affected by genetic and environmental factors like season of birth, year of birth, parity of ewes and sex of lambs (Mengistie 2008). In most traditional systems, first lambing occurs at 15-18 months when ewe weights are 80-85 percent of mature size (Solomon 2007). Year and season of birth in which the ewe lamb was born, influence age at first lambing through their effect on feed supply and quality (Gbangboche et al 2006). Lambing interval is affected by the breed, season (Abebe 1999), year of lambing (Niftalem 1990), season (Mengistie 2008) parity of ewes, post-partum body weight and management practice (Suleiman et al 1990), type of management, nutrition, type of mating (Gbangboche et al 2006). Litter size in sheep can be decreased through abortion which is caused by diseases, poor nutrition, litter size and dam age and genetic factors also play a role in inducing abortion (Ibrahim 1998).

Annual reproduction rate is also related to litter size, lamb mortality and lambing interval (Gautsch et al 1986). It results in part from the uncontrolled access of rams to ewes on a permanent basis and in part from litter size (Tesfaye 2008). Increased economic returns from sheep production require improvements in the market weight of lambs and survival to market age (Mengistie 2008). The growth performance of sheep is influenced by age of the dam/ parity, pre-mating weight of the dam, type of birth, sex, the season and month of birth (Abebe 1999; Solomon 2007). (Markos 2006) reported that birth weight affects the survival rate and pre-weaning growth of the lamb. Lambs heavier at birth have fast growth capacity and have higher mature body weight (Kasahun

2000; Tesfaye 2008). Therefore the objective of the study was to quantify the production objectives and reproductive performance of indigenous sheep in Goncha Siso Enesie District, East Gojjam Zone, Amhara Region, Ethiopia**.**

Materials and Methods

Description of the Study Area

The study was conducted at Goncha Siso Enesie District, East Gojjam administrative zone, in Amhara National Regional State (ANRS), Ethiopia. It was located 338 km North West of Addis Ababa and 156 km South East of Bahir Dar, the regional capital. The district was located in 10°55'N latitude and 38°05' E longitude. The annual rainfall varies from 1100 to 1500 mm and occurs in a bimodal pattern with small rains between March and April and the main rainy season ranges from July to September .The annual mean temperature varies from 15 ºC to 24 ºC with a mean of 19 ºC. Agro ecologically, the district is divided into three climatic zones, 12 % highland (Dega), 48 % midland (Weina Dega) and 40 % lowland (Kola). Altitudes of the district ranges from 1000 to 3400 mater above sea level with 45% plain, 39% adulate, 15% valley and 1% others are major land use patterns.

Data Collection and Procedures

Sampling frame and sample size

The study district was stratified in to three strata. Each stratum was made up of Peasant Associations (PAs) sharing similar characteristics. Altitudes and number of sheep kept were considered as stratification factors. Households in PAs were also stratified by their number of sheep they keep. About 22 PAs (60%) of the district were selected as a sampling population for this study. Representatives of six PAs were selected randomly and the selected PAs were stratified in to small, medium and large population size of sheep they keep as adopted from ILRI (1990). Equal numbers of households were taken randomly from small, medium and large strata in each peasant association respectively. A total of 180 households were included in the survey and all aspects of information from all aspects of production at all levels of livestock holding were collected.

Household survey

Semi-structured questionnaires, formal and informal interviews, focus group discussions with key informants were used to generate information. In addition, information on certain events was gathered based on personal observation. The semi structured questionnaires were adopted from FAO (2011) and Workneh et al (2004). The questionnaires were focused on number of household members, age and gender information, size and type of land holding, numbers and types of livestock species owned. In each study areas, 180 households were interviewed and information about reproductive performances (age at mating, age at first parturition, Lambing interval, average litter size, annual reproduction rate) and about production objectives and management practices were collected.

Body weight and linear body measurements

Measurements of body weight, body length, heart girth and height at wither were taken from 420 indigenous sheep (132 male and 288 females) from each PAs. Measurements were taken from small, medium and large size of sheep population using 100 kg weighing scale of the live and flexible tape (3 meter length) to the nearest 0.5 cm after restraining and holding the animals in an unforced position. Independent variables (sex and age) which have the nominal modeling type were used to separate prediction coefficients to fit each of its levels (sex and age).

Data management and statistical analysis

The date was edited, coded, entered in to Microsoft Excel prior to statistical analysis and analyzed using SPSS statistical package for social science (SPSS 2007) version 16. Descriptive statistics were used to display means and chi-square tests for testing significances. The relationship of body weight and linear body measurements were estimated by Pearson correlation. Indices were also used to estimate ranks of sheep production objectives and shortage of feed problems.

Results and discussion

Farmers’ sheep production objectives

Farmers in the study area involved in sheep production mainly for sales, input and meat supply for households with an index values of 0.257, 0.238 and 0.211, respectively (Table 1).

Table 1. Indices indicating of sheep production objectives in the households

Parameters	Ranks with number of respondents(180) 1st	2nd	3rd	4th	5th	6th	weight	%	index
Income Sources (sale)	92	70	17	0	1	0	972	25.7	0.257(1)
Input	77	34	62	5	2	0	899	23.8	0.238(2)
Meat	8	70	93	9	0	0	797	21.1	0.211(3)
Saving	1	3	5	58	113	0	441	11.7	0.117(5)
Manure	0	0	0	2	2	176	186	4.9	0.049(6)
Social and Cultural Functions	2	3	3	106	62	4	485	12.8	0.128(4)

Indices were calculated as Index= sum of (6 X number of household ranked first + 5 X number of household ranked second + 4 X number of household ranked third + 3 X number of households ranked forth + 2 X number of household ranked fifth + 1 X number of household ranked sixth) given for each purpose divided by sum of (6 X number of household ranked first + 5 X number of household ranked second + 4 X number of household ranked third + 3 X number of households ranked forth + 2 X number of household ranked fifth + 1 X number of household ranked sixth) for all purpose of keeping sheep in a production system.

Feed shortage

The main problem of sheep productions in the study area was shortage of feeds. The most important problems listed were shrinking and decline in productivity of grazing land, cultivation, settlement and protection of grazing lands and growth of human population with an index value of 0.308, 0.265 and 0.157, respectively (Table 2). Declining yield and carrying capacity of the grazing lands was rated as the second important impediment in adequate supply of feeds across all the sites.

Table 2.Reasons of feed shortage in the district

Parameters	Number of respondents n=172 1st	2nd	3rd	4th	5th	weight	%	ranking
Shrinking and decline in Productivity of grazing land	123	38	8	3	0	797	30.8	0.308(1)
Increase of animal population	1	9	36	20	107	296	11.4	0.114(5)
Cultivation, settlement and protection of grazing lands	33	108	27	4	1	687	26.5	0.265(2)
Drought	10	8	51	64	40	403	15.6	0.156(4)
Increase of human population	6	10	49	82	26	407	15.7	0.157(3)

Index= sum of (5 X number of household ranked first + 4 X number of household ranked second + 3X number of household ranked third + 2 X number of households ranked forth + 1 X number of household ranked fifth) given for each purpose divided by sum of (5 X number of household ranked first + 4 X number of household ranked second + 3 X number of household ranked third + 2 X number of households ranked forth + 1 X number of household ranked fifth) for all reasons feed shortage in the district.

Reproductive performances

The average ages of first mate or sexual maturity in male and female sheep were 11.14 ± 0.253 and 11.64 ± 0.26 months, respectively and ranged from 5-24 months for both sexes. The ages of first parturitions of males and females sheep were 16.19 ± 0.248 and 16.74 ± 0.249 months, respectively. Lambing interval of sheep in this study area was 289.2 days. Besides, the annual reproductive rate and litter size of the sheep in the study area were 1.41 ± 0.12 and 1.11± 0.023, respectively (Table 3).

Table 3. Reproductive performance parameters of sheep flock.

Parameters	Study areas (peasant associations) with corresponding households (N) Yewaye (N = 30)	Enezeba (30)	Embawch (30)	Chemo (30)	Gomt Slasie (30)	Gozamen (30)	Over all (180)
Age at first mate							
Male	9.20±0.360	9.60±0.584	12.50±0.686	11.40±0.552	12.43±0.684	11.73±0.549	9.20±0.360
Female	10.07±0.386	10.37±0.775	13.33±0.781	12.07±0.489	12.70±0.640	11.30±0.445	10.07±0.386
Age at first parturition or lambing (Mean ± SE)							
Female	15.20±0.354	15.73±0.701	18.37±0.772	17.07±0.489	17.70±0.640	16.37±0.438	16.74±0.249
Slaughter /marketing age (Mean ± SE)							
Male	3.80±0.121	5.03±0.155	4.00±0.127	5.00±0.179	5.13±0.202	4.07±0.235	3.80±0.121
Female	3.73±0.117	5.50±0.142	3.80±0.130	4.53±0.213	4.87±0.270	4.17±0.240	3.73±0.117
Lambing interval	9.3±0.204	9.47±0.270	9.63±0.251	9.87±0.252	9.50±0.266	10.1±0.281	9.3±0.204
Prolificacy %							
Single lambing	63.3	100	96.7	83.3	93.3	96.7	88.9
Twining	36.7	-	3.3	16.7	6.7	3.3	11.1
Litter size (Mean ± SE)	1.37±0.089	1.00±00	1.03±0.033	1.17±0.069	1.07±0.046	1.03±0.033	Litter size (Mean ± SE)
Annual reproductive rate	1.80	1.28	1.30	1.44	1.37	1.24	1.41 ± 0.1

n=number of respondents

The average age of maturity of sheep at Goncha Siso Enesie district fall within the range of maturity age reported for most of the tropical sheep breeds under traditional management systems (Wilson 1991). Shrinking sizes and decline in productivity of the grazing lands driven by the expansion of land cultivation settlement and protection on grazing lands was reported to be the leading reasons for feed shortage across all the study sites but it was more critical in chemo, Gnezeba and Gomt slasie than in the others. Age at first parturition observed in this study was 16.74 months. This was comparable to the findings of Abebe (1999); Tesfaye (2008) Mengistie (2008) and reported as 15, 22 and 15.5 months of age, respectively for most Ethiopian sheep breeds. FAO (2002) reported age at first lambing ranges between 16.2 and 16.9 months in mixed farming systems of sub-Sahara African countries.

Lambing interval of sheep in this study area was 289.2 days. The result was in the range of Abebe (1999), Tesfaye (2008) which was about 283.5-395 days in Menz sheep breeds. But different from the report of Aden (2003) and Fikrte (2008) with lambing interval of 336.95 days and 313.8 days in Afar and black head Somali sheep breeds respectively.

Litter sizes of the sheep in this study were 1.11 and were similar to Mengistie (2008) in Washera sheep. FAO (2002) reported prolificacy of sheep ranging between 1.09 and 1.16 for sheep in mixed farming systems. From the group discussion made in the study area, twining was not common observed especially after 10 to 15 years. About 87.5 % fertility rate ewes observed in this study was below the findings of Awotwi and Fynn (1992) who reported 93.3% in sheep under backyard systems of southern Ghana. However, it was higher than findings of Mukasa-Mugerwa et al (2002) (76%) in Menz and (67%) in Horro Ethiopian highlands sheep.

Seasonality in lambing/conception/breeding

Lambs were born in every month of the year across the surveyed district, and most frequently between November and December followed by the months from March to May (Figure 4). In general; it was found that 70.4% of the lambing occurred during this season indicating that the conception rates were highest. These are because of accessibility of feed sources as the key informants put the main reason for this time during group discussion.

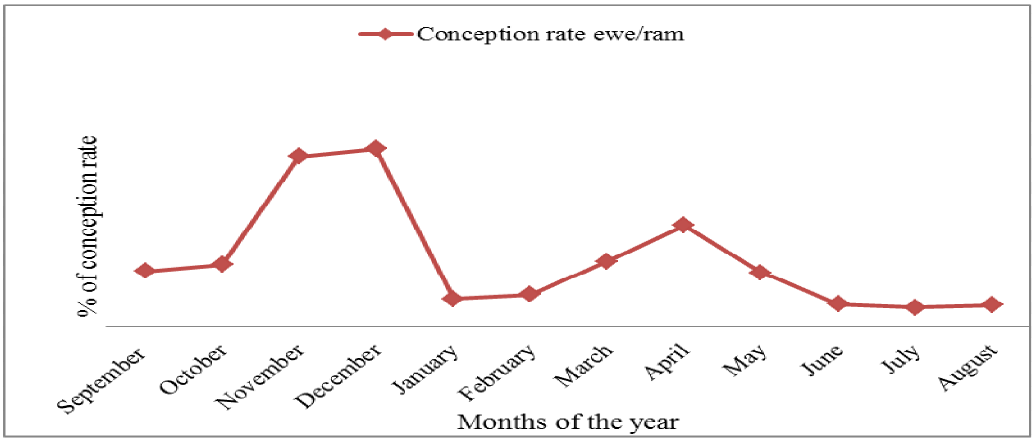

Figure 1. Intensive breeding and conception season /months during the year.

Physical Characteristics and Linear Body Measurements

Body weight and linear body measurements

The average body weight of male in four age groups with one, two three and four pairs of permanent incisors were recorded to be 17.64±0.57, 22.55±0.99, 24.16 ±0.36, and 35.31±0.67 kg, respectively. The body weights for females in these age groups were 16.36±0.36, 19.96±0.64, 23.67±0.32 and 32.76±0.38 kg, respectively. The mean height at withers in male in the four age groups were 54.36±0.73, 61.40±0.39, 62.36 ±0.34, and 78.07±0.93, cm, respectively while that of female in these age groups were recorded to be 52.20±0.49, 58.53±1.01, 60.23±0.24, and 74.71±0.70, cm, respectively. The mean heart girth in male of four age groups were 57.78±0.74, 64.47±0.39, 65.91±0.61, and 85.61±0.99, cm, respectively while that of female in the same age groups were 56.31±0.48, 62.67±0.94, 65.61±0.28 and 81.75±0.78 cm respectively. The body length of males in these age groups were.76.58±0.58, 75±0.16, 60.07±0.33 and 77.77±1.82 cm while that of female in these age groups were 50.32±0.45,56.18±0.92,59.60±0.32 and 72.50±0.86 cm, respectively.

Table 4. Body weight and LBM by sex and age groups (Means± SE)

Age group	sex	N	WH*(cm)	HG**(cm)	BL*(cm)	BW*(kg)
1PPI	male	42	54.36± 0.73	57.78± 0.74	51.76± 0.58	17.64± 0.57
	female	71	52.2± 0.49	56.31± 0.48	50.32± 0.45	16.36± 0.36
	pooled	113	53.00± 0.42	56.86± 0.41	50.85± 0.36	16.85± 0.31
2PPI	male	32	61.40± 0.39	64.47± 0.39	58.75± 0.16	22.55± 0.99
	female	62	58.53± 1.01	62.61± 0.94	56.18± 0.92	19.96± 0.64
	pooled	94	59.51± 0.83	63.24± 0.78	57.05± 0.73	20.84± 0.55
3PPI	Male	44	61.36±0.34	65.91±0.61	60.07±0.33	24.16±0.36
	Female	65	60.23±0.24	65.61±0.28	59.60±0.32	23.67±0.32
	Pooled	109	60.69±0.21	65.73±0.30	59.79±0.23	23.87±0.24
4PPI	male	13	78.07± 0.93	85.61± 0.99	77.77± 1.82	35.31± 0.67
	female	91	74.71± 0.70	81.75± 0.78	72.50± 0.86	32.76± 0.38
	pooled	104	75.13± 0.63	82.23± 0.71	73.16± 0.80	33.08± 0.35

*HW = Height at withers; HG = Heart Girth BL = Body length; BW = Bodyweight; n=No. of observations, PPI= pairs of permanent incisors (1, 2, 3 and 4 pairs) **Correlation is significant at 0.01 level; *Correlation is significant at 0.05 level

Males were higher than females in body weight, height at withers, heart girth and body length across all age categories. This result is in line with Markos et al (2004) and stated that male sheep generally grow faster and are heavier with superior body conformational measurements than female sheep. All linear body measurements and body weight significantly differed (P<0.05) among all age groups of sheep.

Relationship between body weight and linear body measurements

Positive and highly significant (P <0.01) correlation were observed between body weight and linear body measurements for both sex and age groups. The pooled values of the three linear measurements were higher than in each sex and age group correlation coefficients as shown in table 5. These are may be the number of the samples sizes increase the correlation coefficient relationship express in more and also might be due to more or less similar environmental influence at different age groups.

Table 5. Correlation coefficients between body weight and linear body measurements

Age group	Sex	N	HW	HG	BL
1PPI	Male	42	0.4437**	0.4969**	0.5152**
	Female	71	0.5493**	0.4538**	0.3220**
2PPI	Male	32	0.7080**	0.7300**	0.4271**
	Female	62	0.7904**	0.8063**	0.4752**
3PPI	Male	44	0.6191**	0.8542**	0.1640**
	Female	65	0.2614**	0.2843**	0.2409**
4PPI	Male	13	0.5150**	0.5130**	0.4530**
	Female	91	0.6533**	0.8010**	0.4346**
Pooled	Male	131	0.8330**	0.8353**	0.8049**
	Female	289	0.9017**	0.9230**	0.8264**

HW = Height at withers; HG = Heart Girth; BL = Body length; *N = number of observations; **Correlation is significant at 0.01 level; *Correlation is significant at 0.05 level.*

Good correlation coefficients between body weight and heart girth in different age categories were also reported for Menz and Afar sheep breeds (Tesfaye, 2008). (Mengstie, 2008) also reported correlation coefficients observed between body weight and body measurements for all age groups in Washera sheep breed. (Markos, et al 2004) have also reported strong and positive correlation between body weight and other linear body measurements in Menz sheep. In this report the correlation between body length and body weight in 3PPI were reported to be lower than for all age categories of sheep in both sexes. The high correlation coefficients between body weight and body measurements for all age groups suggest that either of these variables or their combination could provide a good estimate for predicting live weight of sheep. From this tends to conclude that at different ages different conformational traits may be more successfully used for selection. Looking at the values of the correlation coefficients, in general, males showed a higher tendency of relationship than that of females' sheep. The findings of the study agree to (Markos, et al 2004). Linear body measurements had high correlation with body weight, this may be used as selection criteria and the correlations coefficients observed in Goncha Siso Enesie district highland sheep were comparable to the reported values of Kassahun (2005) for Menz and Horro sheep and Seare (2007) for Abergelle and Degua sheep.

Regression models for body weight from linear body measurements

Among the body measurements heart girth had the highest correlation coefficient with weight in both sexes at all age groups. It was highest for males at age group 2 and 4 and at age group 2 and 3 for females. The correlation coefficient between weight and withers height was highest at age group 3 for males and at age group 1 and 4 for females. Similarly the highest correlation between weight and body length was found at age group 1 for males. The correlation between body weights and body measurements for all age and sex groups for the pooled were higher than those at different age and sex groups. The correlation coefficients observed between body weight and body measurements for all age groups suggest that either of these variables or their combination could provide a good estimate of predicting live weight of Goncha sheep breeds at different age groups.

Table 6. Regression models for predicting body weight of Goncha Siso Enesie district sheep at different age groups

Age group	Models	a	b_1	b_2	b_3	R^2	SEM
1PP1	$a+b_1WH$	-3.691	0.387	-	-	0.27	2.851
	$a+b_1WH+b_2HG$	-4.241	0.374	0.021	-	0.27	3.491
	$a+b_1WH+b_2HG+b_3BL$	-4.176	0.376	0.21	-0.004	0.27	3.507
2PPI	$a+b_1WH$	-8.607	0.380	-	-	0.65	3.182
	$a+b_1WH+B_2HG$	-13.37	0.142	0.404	-	0.62	4.202
	$a+b_1WH+B_2HG+b_3BL$	-9.008	0.366	0.378	-0.281	0.38	3.916
3PPI	$a+b_1BL$	10.472	0.224	-	-	0.40	2.437
	$a+b_1BL+b2WH$	5.394	0.165	1.42	-	0.43	2.433
	$a+b1BL+b_2WH+b_3HG$	5.530	0.168	0.146	-0.008	0.34	2.445
4PP1	$a+b_1HG$	-0.027	0.403	-	-	0.64	2.189
	$a+b_2HG+b_2BL$	0.578	0.493	0.110	-	0.66	2.109
	$a+b_1HG+b_2BL+b_3WH$	0.218	0.473	-0.123	0.040	0.66	2.117
Pooled	$a+b_1HG$	-15.24	0.581	-	-	0.81	3.069
	$a+b_1HG+b_2WH$	-16.03	0.455	0.148	-	0.83	3.407
	$a+b_1HG+b_2WH+b_1BL$	-15.91	0.467	0.192	-0.061	0.83	3.401

HG = Heart girth; BL =Body length; WH = wither Height. Dependent Variable: BW=body weight SE=standard error 1PPI=one pair of incisor, 2PPI=two pair of incisor, 3PPI=three pair of incisor and 4PPI=four pair of incisor

Table 7. Regression models for predicting body weight of Goncha Siso Enesie district sheep at different age groups by sex

Age group	sex	Model	a	b_1	b_2	b_3	R^2	SEM
1PPI	Male	$a+b_1BL$	-8.807	0.511	-	-	0.25	3.234
		$a+b_1BL+b_2HG$	-11.169	0.326	0.207	-	0.27	3.193
		$a+b_1BL+b_2HG+b_3WH$	-11.194	0.326	0.201	0.007	0.25	3.235
	Female	$a+b_1WH$	-4.307	0.396	-	-	0.29	2.519
		$a+b_1WH+b_2HG$	-3.104	0.484	0.103	-	0.29	4.255
		$a+b_1WH+b_2HG+b_3+BL$	0.951	0.702	-0.181	-0.22	0.31	4.193
2PPI	Male	$a+b_1HG$	-11.034	0.521	-	-	0.52	3.912
		$a+b_1HG+b_2BL$	-5.257	0.764	-0.365	-	0.57	3.686
		$a+b_1HG+b_2BL+b_3WH$	-4.609	0.484	-0.391	0.203	0.56	3.733
	Female	$a+b_1HG$	-14.369	0.548	-	-	0.64	3.023
		$a+b_1HG+b_2BL$	-12.135	0.712	-0.222	-	0.68	2.019
		$a+b_1HG+b_2BL+b_3WH$	-9.502	0.412	-0.270	0.322	0.69	4.724
3PPI	Male	$a+b_1WH$	19.277	0.080	-	-	0.18	2.385
		$a+b_1WH+b_2HG$	20.207	0.107	-0.040	-	0.38	2.407
		$a+b_1WH+b_2HG+b_3BL$	15.041	-0.09	0.067	0.235	0.34	2.404
	Female	$a+b_1HG$	2.815	0.318	-	-	0.66	2.480
		$a+b_1HG+b_2WH$	-3.143	0.226	0.199	-	0.68	4.167
		$a+b_1HG+b_2WH+b_3BL$	-4.696	0.174	0.106	0.176	0.62	4.181
4PPI	Male	$a+b1HG$	-1.348	0.428	-	-	0.34	1.970
		$a+b1HG+b2WH$	-0.928	0.463	-0.044	-	0.28	2.065
		$a+b_1HG+b_2WH+b_3BL$	-10.229	0.760	-0.090	-0.162	0.26	2.096
	Female	$a+b_1WH$	0.622	0.393	-	-	0.64	2.209
		$a+b_1WH+b_2HG$	1.688	-0.096	0.468	-	0.64	4.397
		$a+b_1WH+b_2HG+b_3BL$	1.175	0.065	0.457	-0.147	0.67	4.214
Pooled	Male	$a+b_1HG$	-13.301	0.556	-	-	0.69	3.456
		$a+b1HG+b_2WH$	-15.369	0.307	0.300	-	0.71	3.376
		$a+b_1HG+b_2WH+b_3BL$	-15.709	0.247	0.236	0.139	0.71	3.355
	Female	$a+b1HG$	-16.117	0.591	-	-	0.85	2.870
		$a+b_1HG+b_2WH$	-16.365	0.081	0.520	-	0.85	1.705
		$a+b_1HG+b_2WH+b_3BL$	-16.170	0.164	0.531	0.101	0.85	1.692

HG = Heart girth; BL =Body length; WH = wither Height. Dependent Variable: BW=body weight SE=standard error 1PPI=one pair of incisor, 2PPI=two pair of incisor, 3PPI=three pair of incisor and 4PPI=four pair of incisor

The coefficient of determination (R^2) represents the proportion of the total variability explained by the model. Heart girth was the first variable to explain more variation than other variables in both males (69.5% to 71.3%) and females (85.2% to 85.4%) of Goncha Siso Enesie district high land sheep. when new variable added to the model, which variable will notably increase the coefficient of Generally the R^2 value was higher for female than male. The R^2 and standard error (SE) were the criteria used to select the model. The R^2 always increase as new variable was added to the model thus we have to consider determination (R^2) when added to the model. Standard error usually decreased when new variables were added to the model but addition of unnecessary variable to the model can increase the SE. Generally, in most cases where regression analysis is applied, there can be several potential independent variables that could be included in the model. It is often not easy which variables are really needed in the model. Precision of the model becomes less when we use few variables in the model and inclusion of many variables lead to multi co linearity (Kaps and Lamberson, 2004). After HG; the addition of other variables in the model increased .The result of the multiple regression analyses indicated that the addition of other measurements to HG would result in significant improvements in accuracy of prediction even though the extra gain was small. Besides the statistical concept and precision we should consider simplicity of measurement in order to select independent variables.

Males were higher than females in terms of body weight, height at withers, and heart girth and body length across all age categories. Heart girth significantly ($P<0.05$) differed among the age group one, two, three and four of male and female sheep. This result agrees with Markos *et al (*2004) stated that male sheep generally grow faster and are heavier with superior body conformational measurements than female sheep. All linear body measurements and body weight significantly differed ($P<0.05$) among all age groups of sheep.

Conclusion

Farmers involved in sheep production mainly for sales. However, the main constraint in sheep production and reproduction were shortage of grazing lands or alternative feed resources. The annual reproductive rate and litter size of the sheep were very low. This was directly linked to lack of sufficient feeds with appropriate nutrient content that could increase the reproductive performances of the indigenous sheep. It was also found that sex and age had effects on body weight and body linear measurements which, in turn play a significant role of enhancing the reproductive performance of the indigenous sheep in the area. As the farmers' interest inclined to income generation, production and reproduction of sheep should be supported by intensive production systems and value chain analyses.

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