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Indigenous Sheep Populations in Western Zone of Tigray Region, Ethiopia: Characterization of Major Husbandry Practices and Lambing Patterns

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ABSTRACT

The survey was conducted before the ignition of the war (before October 2020) in Tigray Regional State, Ethiopia. The objective of the survey was to characterize the major husbandry practices and lambing patterns of the indigenous sheep populations. Begait (126), Rutanna (37) and Arado (90) sheep sample households who totaled 253 households were randomly involved in the face-to-face single visit survey interview. Statistical Package for Social Sciences software was used for statistical data analysis. About 50% of the Arado respondents were illiterate whereas 48% of Begait and 57% of Rutanna respondents attended lower primary school. The mean (±SD) number of females greater than one-year-old (35.75±54.8, 90.92±76.4 and 6.00±4.1) and mean (±SD) number of females 6 months to one-year-old (15.26±16.3, 48.62±48.5 and 0.89±1.6) were the major proportions in Begait, Rutanna and Arado sheep flocks, respectively. The mean (±SD) flock size of Rutanna sheep (223.08±170.5) was not comparable with the flock sizes of Begait (85.07± 90.1) and Arado (11.72±8.0). However, there was similar downward flock dynamics in Begait and Rutanna sheep flocks. Animals went to water source to drink water in 75% of Begait, 24% of Rutanna and 83% of Arado respondents. River was the water source for the animals of (45% of Begait and 79% of Arado) respondents whilst piped water was the water source in about 46% of Rutanna respondents. Animals travelled a watering point distance of 1-5 kilo meter (km) to obtain water (60% of Begait and 58% of the Arado respondents) whilst the animals of 32% of Rutanna respondents drunk at household site. Once a day drinking was in animals of 88% of Begait and 73% of Rutanna respondents whereas animals in 77% of Arado respondents drunk water twice a day in the dry season. Diseases and external parasites (EPs) occurrences were in Begait (95%, 86%), Rutanna (100%, 97%) and Arado (68%, 64%) respondents, respectively. Dry and wet season (60% of Begait, 95% of Rutanna and 46% of Arado respondents) was the major season of occurrences of EPs. Nevertheless, 72% of Begait, 41% of Rutanna and 100% of Arado respondents did not get access to

veterinary service center (VSC). Moreover, 85% of Begait, 95% of Rutanna and 100% of Arado respondents travelled a distance of greater than 10 km to the nearest VSC. Own ram use (87% of Begait, 100% of Rutanna and 29% of Arado) and own flocks ram birth (63% of Begait, 81% of Rutanna and 22% of Arado) respondents were practiced. Uncontrolled mating was practiced in 54% of Begait, 22% of Rutanna and 100% of Arado respondents due to communal grazing. Respondents used rams outside of their own flocks (69% of Begait, 65% of Rutanna and 100% of Arado). Respondents used unknown ram to ewe ratio (43% of Begait and 38% of Rutanna) and 83% of the Arado respondents used a ratio of one ram to all ewes in the flock. It was also noted that 62% of Rutanna respondents practiced crossbreeding with Begait sheep. The peak lambing months of Begait and Rutanna sheep were in October and November whilst that of Arado sheep were in September, October and November. Ram castration was practiced in about 10% of Begait, 35% of Rutanna and 69% of Arado respondents. Ram castration was mainly practiced to improve carcass quality (69% of Arado respondents), and the animals were mainly castrated in 2-3 years old (48% of Arado respondents). Traditional castration method was practiced in 64% of Arado respondents. Education, controlled mating and breeding, castration to control inbreeding, access to nearby water and access to veterinary service center should be future attentions of the farmers and stakeholders.

Key words: Characterization, indigenous sheep, husbandry practices, mating practices, lambing pattern

INTRODUCTION

Sheep (*Ovis aries*) was the first domesticated livestock species during 11,000 to 9,000 BC in Southwest Asia from its wild ancestry of Ovis orientalis (Oldenbroek and Van der, 2014). Sub-alpine, wet highland, sub-humid lowland and arid lowland are the ecological zones of Ethiopia which hosted for the different sheep populations. Ethiopia is a home for about nine genetically distinct breeds and six breed groups (Solomon, 2008). About 75% of the sheep population in Ethiopia are found in mixed crop-livestock systems of the highland landscapes and ecologies whilst 25% of the sheep inhabit in the lowlands (DAGRIS, 2006). Productivity in terms of growth rate and carcass yield of the indigenous sheep breeds of Ethiopia are generally characterized at low level (Mengesha and Tsega, 2012). Productivity of sheep in Ethiopia is extremely low due to several technical, institutional, environmental and infrastructural constraints (Markos, 2006). Performances of sheep are affected by nutrition where consideration of availability of nutrients, feeding system type and level of feeding improve performances of sheep (ILRI, 2008).

Characterization studies are essentially paramount important for planning at local, national, regional and global levels for improvement, sustainable utilization and conservation strategies of a breed (FAO, 2012). Rutanna sheep was reported by many authors (Sisay, 2002; Solomon and Gemeda, 2004; Workneh *et al*., 2004), however, Begait and common Tigray highland sheep were not reported. The Arado sheep population is also known as common Tigray highland sheep (Gebretsadik & Anal, 2014). Moreover, Solomon (2008) did not include indigenous Begait sheep population, Rutanna sheep population and Arado sheep population in his comprehensive study of sheep resources of Ethiopia.

Rutanna sheep is one of the desert sheep genetic resources of Sudan and are mainly kept for mutton production. Rutanna sheep population was introduced to Kafta Humera (May Kadra and Bereket Kebelles)

district from Sudan. The communities of May Kadra and Bereket Kebelles of Kafta Humera district are border to Sudan and preferred Rutanna sheep to Begait due to their fast growth rate and coat color pattern of cross-border market preferences. The Rutanna sheep is highly demanded by the Sudanese people, and there was mass sale of Rutanna sheep to the Sudanese people. The Rutanna sheep breed is preferred in border markets in the Western Ethiopia for export due to its higher growth rate and big body size (Ali, 2003; Mohammed, 2015). Moreover, Yohannes *et al*. (2018) indicated that Rutanna sheep has better growth performance as compared to Gumuz sheep growth performance.

The husbandry practices and production performances of Begait sheep population, Rutanna sheep population (a transboundary breed) and Arado sheep population in the lowland and highland areas of Western Zone of Tigray, Ethiopia are not yet intensively characterized except the recent works of Teweldemedhn *et al*. (2023) and Mekonnen *et al*. (2023). Characterization of the husbandry practices of the indigenous sheep populations will be paramount important to develop a breed management plan for sustainable conservation through utilization. Therefore, the objective of the survey was to characterize the major husbandry practices and lambing patterns of each indigenous sheep population.

MATERIALS AND METHODS

Description of the Study Areas

Kafta Humera, Tsegede and Welkait were the districts where the survey conducted. Kafta Humera district is the lowland part of Western Zone of Tigray Region, Ethiopia whereas Welkait and Tsegede districts are the highland areas of Western Zone of Tigray, Ethiopia. The Agro-climatic and non-arable land uses of the study districts are presented (Table 1).

Data collection and statistical analysis

Kafta Humera (Begait and Rutanna sheep populations), Tsegede and Welkait (Arado sheep population) districts and the Kebelles were purposively selected. Begait (126), Rutanna (37) and Arado (90) sheep respondents which totaled 253 sample households were randomly involved in the face-to-face survey interview.

Statistical Package for Social Sciences (SPSS, 2019) software was used for the analysis of the household survey data. Descriptive statistics (frequency, percentages and mean) was used to summarize the data. Tables and figures are used to present the information. Nonparametric chi-square (X^2) test and mean comparisons were used to test the differences among proportions of variables and populations, and $P<0.05$ was the significance level stated. Moreover, indices were used to know the lambing patterns of indigenous sheep populations.

Index = Sum of (3 **x** number of households who ranked first **+** 2 **x** number of households who ranked second **+** 1 **x** number of households who ranked third) **given for each variable** divided by Sum of (3 **x** number of households who ranked first **+** 2 **x** number of households who ranked second **+** 1 **x** number of households who ranked third) **for all variables**.

Table 1 Agro-climatic and non-arable land use of the study districts

Agro-climate and land use	**Kafta Humera**	**Welkait**	**Tsegede**
Altitude (MASL)	500-1849	700-2354	680-3008
Agro-ecology (%)			
Lowland (*Kola*)	86	60	70
Midland (*Weina dega*)	14	40	22
Highland (*Dega*)	-	-	9
Rainfall (mm)	650-750	700-1800	1200-2500
Temperature (°C)	25-48	18-25	12-35
Non-arable land use (%)			
Forestry land	33	19	35
Pastureland	5	18	22

Meter Above Sea Level (MASL), millimeter (mm) Source: Tesfay *et al*., 2019

RESULTS

Characteristics of Respondents

About 95% of Begait, 100% of Rutanna and 93% of Arado were male headed households who randomly involved in the face-to-face survey interview (Table 2). About half (50%) of the Arado respondents were illiterate whereas 48% of Begait and 57% of Rutanna respondents attended lower primary school (Figure 1). The mean age (51.13±9.7, 50.46±9.4 and 48.18±11.9 years old) and family size (6.22±1.9, 9.51±5.9 and 6.30±1.8) of the Begait, Rutanna and Arado sample households were reported, respectively. The mean arable landholdings cultivated under rain-fed condition of the Begait, Rutanna and Arado sample households were 14.87±42.2, 209.1±244.5 and 1.02±1.0 hectare (ha), respectively. The dominant livestock species (TLU) were sheep (8.51±9.0 in Begait and 22.31±17.1 in Rutanna respondents) and cattle (4.08±2.4 in Arado respondents) (Table 2).

Flock dynamics of Indigenous sheep (Begait, Rutanna and Arado) populations in 2017 production year

The mean (±SD) number of females greater than one-year-old (35.75±54.8, 90.92±76.4 and 6.00±4.1) and mean (±SD) number of females 6 months to one-year-old (15.26±16.3, 48.62±48.5 and 0.89±1.6) were the first and second major proportions in the flocks of Begait, Rutanna and Arado sheep, respectively. The mean (±SD) flock size of Rutanna sheep (223.08±170.5) was not comparable with the flock sizes of Begait (85.07± 90.1) and Arado (11.72±8.0). However, there was similar downward flock dynamics in Begait and Rutanna sheep populations (Table 3).

Table 2 Demography, household livestock and honeybee holding

HH head gender and educational level	Begait sheep respondents	Rutanna sheep respondents	Arado sheep respondents	Overall	*P* value
Gender					
Male	120(95.2)	37(100)	84(93.3)	241(95.3)	
Female	6(4.8)	0	6(6.7)	12(4.7)	
Age and family size of HH head (Mean (±SD)					
Age (years)	51.13±9.7	50.46±9.4	48.18±11.9	49.98±10.6	0.124
Family size	6.22±1.9	9.51±5.9	6.30±1.8	6.73±3.1	0.000
Landholding (ha)					
Arable land (rain-fed)	14.87±42.2	209.1±244.5	1.02±1.0	38.34±120.3	0.000
Irrigation landholding	0.21±0.8	0.33±1.6	0	0.16±0.8	0.065
Grazing landholding	1.29±6.9	14.86±36.5	0	2.82±15.5	0.000
Livestock and honey bee					
Cattle holding (TLU)	6.62±12.6	21.53±41.7	4.08±2.4	7.89±19.0	0.000
Sheep holding (TLU)	8.51±9.0	22.31±17.1	1.17±0.8	7.91±11.4	0.000
Goats holding (TLU)	4.15±4.4	8.79±7.8	0.19±0.4	3.42±5.1	0.000
Chickens holding (TLU)	0.10±0.2	0.21±0.5	0.04±0.1	0.09±0.2	0.001
Donkeys holding (TLU)	0.49±0.6	0.14±0.3	0.88±0.6	0.58±0.6	0.000
Camels holding (TLU)	0.01±0.1	0	0	0.004±0.1	0.606
Honeybees hives (number)	0	0	0.86±1.4	0.3±0.9	0.000
Mules holding (TLU)	0	0	0.03±0.1	0.01±0.1	0.025
Horse holding (TLU)	0	0	0.44±0.8	0.2±0.5	0.000

Frequency followed by percent in parenthesis, SD=Standard Deviation, TLU=Tropical Livestock Unit

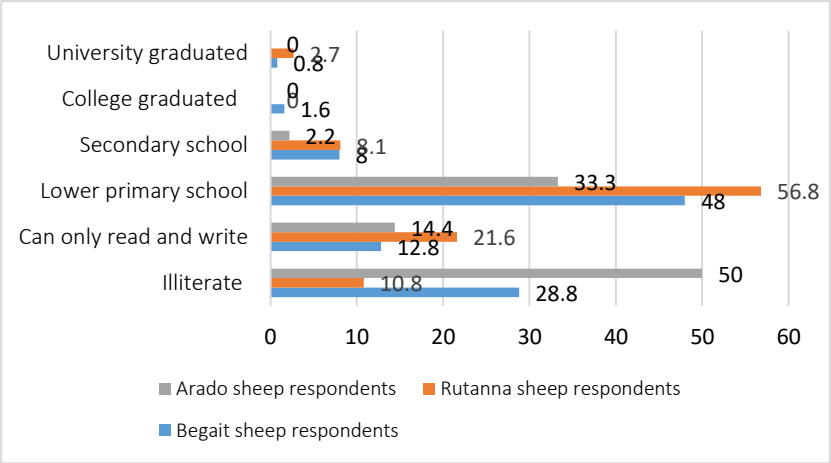


Figure 1 Educational Level of Household Heads (%)

Table 3 Indigenous sheep populations flock structure, flock dynamics of sheep across populations in 2017 (Mean±SD)

Flock by age and sex	Begait sheep	Rutanna sheep	Arado sheep	*P* value
N of male lambs <6 months old	9.27±8.2	23.70±19.2	1.74±1.6	0.000
N of female lambs <6 months old	13.09±12.4	32.11±28.5	2.48±1.9	0.000
N of males 6 months to one year old	5.00±5.9	14.54±19.5	0.27±0.7	0.000
N of females 6 months to one year old	15.26±16.3	48.62±48.5	0.89±1.6	0.000
N of males >1 year old	3.40±4.4	12.16±17.8	0.34±0.6	0.000
N of females >1 year old	35.75±54.8	90.92±76.4	6.00±4.1	0.000
N of castrated males	0.08±0.7	0.92±3.1	0	0.001
Flock size	85.07± 90.1	223.08±170.5	11.72±8.0	0.000
Flock dynamics	**(%)**	**(%)**	**(%)**	
Entries due to birth and others	33.33	38.82	47.77	
Exits due to sale and others	36.00	41.37	50.90	
% change in flock	**-2.67**	**-2.56**	**-3.13**	**-2.65**

N=Number of heads of animals, SD=Standard Deviation

Watering practices in indigenous sheep in the dry season

About 75% of Begait, 24% of Rutanna and 83% of Arado respondents reported that their animals go to water source to drink water. River was the water source for the animals in about 45% of Begait and 79% of Arado respondents whilst piped water was the water source in about 46% of Rutanna respondents. About 60% of Begait and 58% of the Arado respondents indicated that their animals travel a distance of 1-5 kilometer (Km) to obtain water whilst the animals of 32% of Rutanna respondents drunk at household site. It was also indicated that animals of 88% of Begait and 73% of Rutanna respondents drunk water once a day whereas animals in 77% of Arado respondents drunk water twice a day in the dry season (Table 4).

Diseases and external parasites (EPs), and veterinary services

About 95% of Begait, 100% of Rutanna and 68% of Arado respondents reported occurrences of diseases whereas 86% of Begait, 97% of Rutanna and 64% of Arado reported occurrences of EPs. The major season of occurrences of EPs was in dry and wet season (60% of Begait, 95% of Rutanna and 46% of Arado respondents). There was no access to VSC in 72% of Begait, 41% of Rutanna and 100% of Arado respondents (Table 5). About 85% of Begait, 95% of Rutanna and 100% of Arado respondents travelled a distance of greater than 10 kilometers (km) to their proximity VSC (Figure 2).

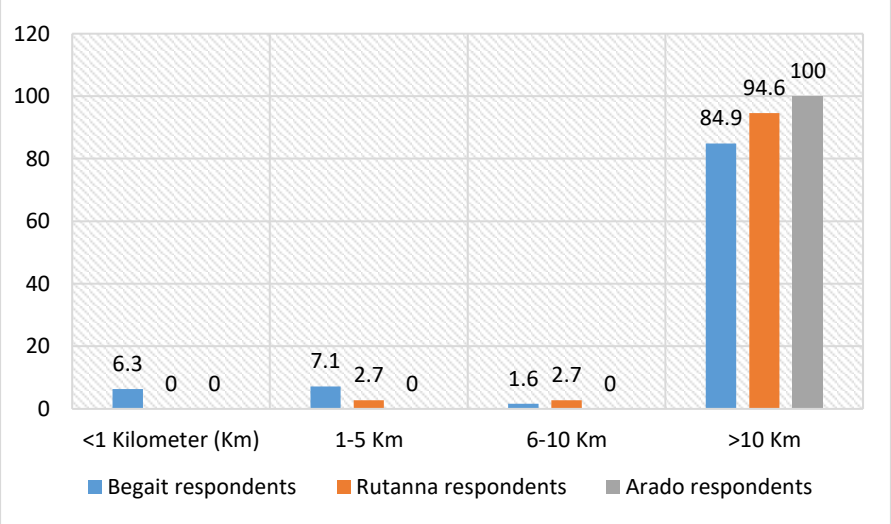


Figure 2 Distance between Veterinary Service Center and Smallholder Farmers (%)

Table 4 Frequency (%) of watering practices of indigenous sheep populations in the dry seasons (n=253)

How to provide water	Begait	Rutanna	Arado
Animals go to water	95(75.4)	9(24.3)	75(83.3)
Water is fetched	20(15.9)	21(56.8)	12(13.3)
Both types	11(8.7)	7(18.9)	3(3.3)
X^2	101.29	9.29	102.60
P value	0.000	0.010	0.000
Water source type			
River	57(45.2)	5(13.5)	71(78.9)
Water well	36(28.6)	9(24.3)	13(14.4)
Piped	7(5.6)	17(45.9)	5(5.6)
Borehole	25(19.8)	6(16.2)	0
River and piped	0	0	1(1.1)
Piped and borehole	1(0.8)	0	0
X^2	81.14	9.59	142.71
P value	0.000	0.022	0.000
Watering point distance			
Household site	7(5.6)	12(32.4)	10(11.1)
<1 Km	21(16.7)	9(24.3)	25(27.8)
1-5 Km	76(60.3)	6(16.2)	52(57.8)
6-10 Km	19(15.1)	5(13.5)	3(3.3)
>10 Km	3(2.4)	5(13.5)	0
X^2	137.33	5.03	62.80
P value	0.000	0.285	0.000
Watering frequency			
Freely available	1(0.8)	2(5.4)	0
Once a day	111(88.1)	27(73.0)	21(23.3)
Twice a day	8(6.3)	8(21.6)	69(76.7)
Once in 3 days	6(4.8)	0	0
X^2	268.35	27.62	25.60
P value	0.000	0.000	0.000

Table 5 Frequency (%) of diseases and external parasites (EP) access to veterinary service, type of veterinary service center (VSC) and distance between VSC and SHFs

Occurrences of diseases	Begait	Rutanna	Arado
Yes	120(95.2)	37(100.0)	61(67.8)
No	6(4.8)	0	29(32.2)
Occurrences of EP			
Yes	108(85.7)	36(97.3)	58(64.4)
No	18(14.3)	1(2.7)	32(35.6)
Season of occurrence of EP			
Dry season	32(25.4)	1(2.7)	17(18.9)
Wet season	0	0	0
Dry and wet seasons	76(60.3)	35(94.6)	41(45.6)
No EP	18(14.3)	1(2.7))	32(35.6)
X^2	44.89	60.50	9.80
P value	0.000	0.000	0.007
Access to VSC			
Yes	35(27.8)	22(59.5)	0
No	91(72.2)	15(40.5)	90(100.0)
Type of VSC			
Government VSC	35(27.8)	22(59.5)	0
No VSC	91(72.2)	15(40.5)	90(100.0)

SHFs=Smallholder farmers

Mating and breeding practices in indigenous sheep

About 87% of Begait, 100% of Rutanna and 29% of Arado respondents used their own ram for mating. The sources of the rams of 63% of Begait, 81% of Rutanna and 22% of Arado respondents were born in their own flocks. Uncontrolled mating was practiced in 54% of Begait, 22% of Rutanna and 100% of Arado respondents due to the fact that the sheep graze in communal lands. About 69% of Begait, 65% of Rutanna and 100% of Arado respondents used rams outside of their own flocks (Table 6). About 43% of Begait and 38% of Rutanna respondents used unknown ram to ewes ratio and 83% of the Arado respondents used a ratio of one ram to all ewes in the flock (Figure 3). It was also noted that 3% of Begait, 62% of Rutanna and 9% of Arado respondents practiced crossbreeding (Table 6).

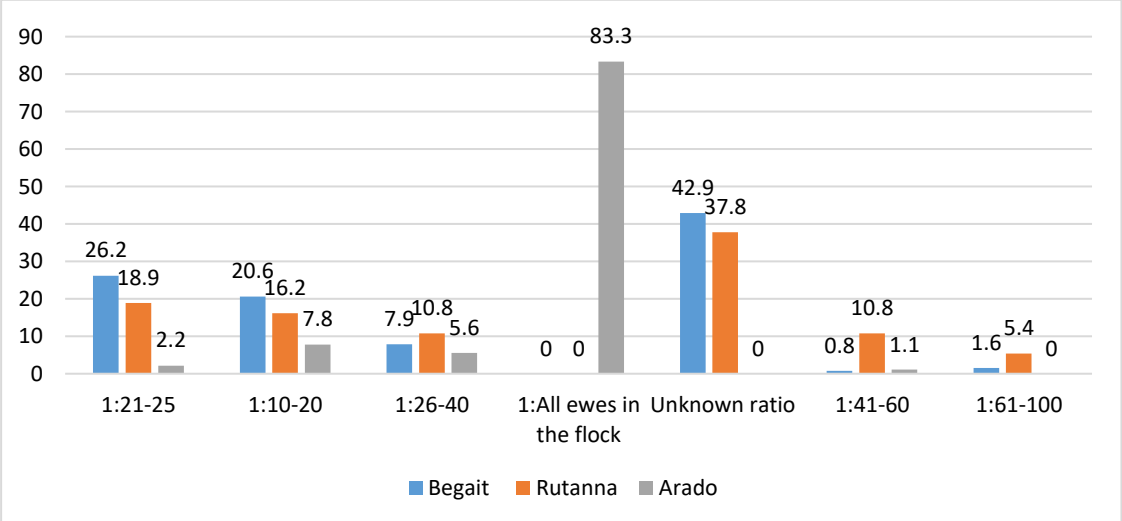
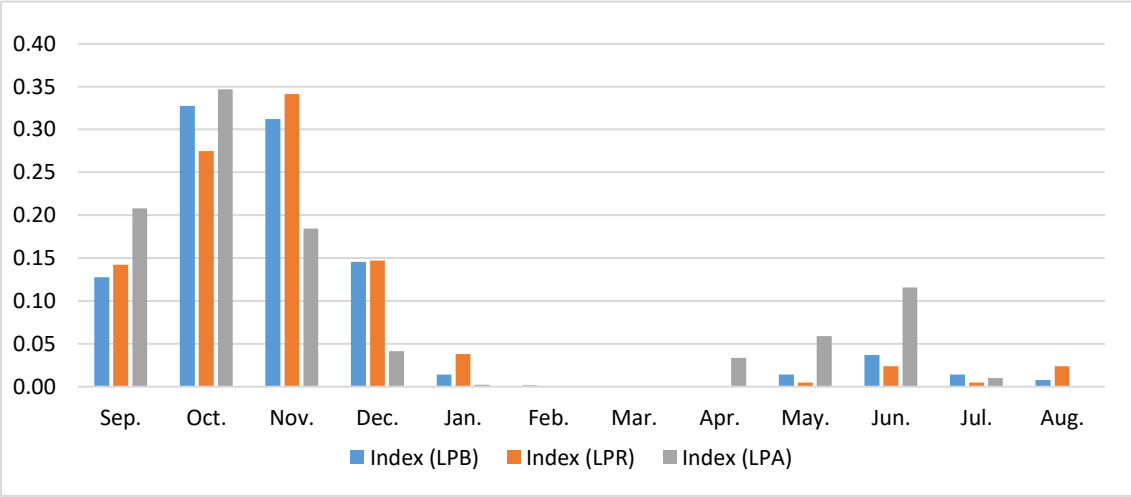


Figure 3 Ratio of Ram to Ewes (%)

Table 6 Frequency (%) of mating and breeding practices of indigenous sheep populations (n=253)

Own ram use	Begait	Rutanna	Arado
Yes	110(87.3)	37(100)	26(28.9)
No	16(12.7)	0	64(71.1)
Breeding ram source			
Born in flock	79(62.7)	30(81.1)	20(22.2)
Bought	17(13.5)	3(8.1)	3(3.3)
Born in and bought	14(11.1)	4(10.8)	3(3.3)
No own ram	16(12.7)	0	0
X^2	95.65	38.00	110.62
P value	0.000	0.000	0.000
Type of mating			
Uncontrolled	68(54.0)	8(21.6)	90(100)
Controlled	58(46.0)	29(78.4)	0
Reason(s) for uncontrolled mating			
Community sheep graze together	68(54.0)	8(21.6)	90(100.0)
Controlled	58(46.0)	29(78.4)	0
Ram use outside own flock			
Yes	87(69.0)	24(64.9)	90(100.0)
No	39(31.0)	13(35.1)	0
Reason(s) for ram use outside own flock			
No own ram	16(12.7)	0	64(71.1)
To get better ram	35(27.8)	17(45.9)	24(26.7)
No control	33(26.2)	7(18.9)	2(2.2)
To avoid inbreeding	3(2.4)	0	0
Only own ram use	39(31.0)	13(35.1)	0
X^2	36.69	4.11	65.87
P value	0.000	0.128	0.000
Crossbreeding practice			
Yes	4(3.2)	23(62.2)	8(8.9)
No	122(96.8)	14(37.8)	82(91.1)



LPB=Lambing Pattern of Begait, LPR=Lambing Pattern of Rutanna and LPA=Lambing Pattern of Arado

Figure 4 Lambing patterns of indigenous sheep populations across a year

Table 7 Index of Lambing Patterns of Indigenous Sheep Populations across months of a year

Month	Begait sheep				Rutanna sheep				Arado sheep			
	R_1	R_2	R_3	Index	R_1	R_2	R_3	Index	R_1	R_2	R_3	Index
Sep.	30	2	7	0.13	7	1	7	0.14	24	16	2	**0.21**
Oct.	54	39	19	**0.33**	7	15	7	**0.27**	35	28	16	**0.35**
Nov.	38	52	29	**0.31**	16	9	6	**0.34**	6	27	22	**0.18**
Dec.	6	25	47	0.15	2	9	7	0.15	1	3	12	0.04
Jan.	1	1	6	0.01	2	0	2	0.04	0	0	1	0.00
Feb.	0	0	1	0.00	0	0	0	0.00	0	0	0	0.00
Mar.	0	0	0	0.00	0	0	0	0.00	0	0	0	0.00
Apr.	0	0	0	0.00	0	0	0	0.00	3	3	2	0.03
May.	2	1	3	0.01	0	0	1	0.00	6	5	2	0.06
Jun.	2	7	9	0.04	1	0	2	0.02	14	3	11	**0.12**
Jul.	1	2	4	0.01	0	0	1	0.00	1	1	0	0.01
Aug.	1	1	1	0.01	1	0	2	0.02	0	0	0	0.00

Sep.=September…Aug.=August

Table 8 Frequency (%) of ram castration practices in indigenous sheep populations (n=253)

Ram castration practice	Begait	Rutanna	Arado
Yes	13(10.3)	13(35.1)	62(68.9)
No	113(89.7)	24(64.9)	28(31.1)
Reason(s) for castration			
Control inbreeding	1(0.8)	6(16.2)	0
Improve carcass quality	12(9.5)	7(18.9)	62(68.9)
No castration	113(89.7)	24(64.9)	28(31.1)
X^2	181.48	16.59	12.84
P value	0.000	0.000	0.000
Castration age			
3-6 months	0	5(13.5)	0
2-3 years	11(8.7)	6(16.2)	43(47.8)
4-5 years	2(1.6)	2(5.4)	19(21.1)
No castration	113(89.7)	24(64.9)	28(31.1)
X^2	181.00	32.29	9.80
P value	0.000	0.000	0.007
Method of castration used			
Burdizzo	0	4(10.8)	2(2.2)
Traditional	13(10.3)	9(24.3)	58(64.4)
Traditional and burdizzo	0	0	2(2.2)
No castration	113(89.7)	24(64.9)	28(31.1)
X^2	79.37	17.57	94.71
P value	0.000	0.000	0.000

Lambing patterns of Indigenous sheep populations

The major lambing months of Begait and Rutanna sheep were in October and November whereas the major lambing months of Arado sheep were in September, October and November. The second lambing months of Begait and Rutanna sheep were September and December whilst the other lambing month of Arado sheep was in June (Table 7 and Figure 4).

Ram castration practices

About 10% of Begait, 35% of Rutanna and 69% of Arado respondents practiced ram castration at different ages of the animals. The purpose of ram castration was mainly to improving carcass quality (10% of Begait, 19% of Rutanna and 69% of Arado respondents), and the animals were mainly castrated in 2-3 years old (9% of Begait, 16% of Rutanna and 48% of Arado respondents). Traditional castration method was practiced in 10% of Begait, 24% of Rutanna and 64% of Arado respondents (Table 8).

DISCUSSION

The dominant livestock species (TLU) in the study area were sheep (8.51±9.0 in Begait and 22.31±17.1 in Rutanna respondents) and cattle (4.08±2.4 in Arado respondents). The mean (±SD) number of females greater than one-year-old (35.75±54.8, 90.92±76.4 and 6.00±4.1) and mean (±SD) number of females 6 months to one-year-old (15.26±16.3, 48.62±48.5 and 0.89±1.6) were the first and second major proportions in the flocks of Begait, Rutanna and Arado sheep, respectively. The mean (±SD) flock size of Rutanna sheep (223.08±170.5) was not comparable with the flock sizes of Begait (85.07± 90.1) and Arado (11.72±8.0). However, there was similar downward flock dynamics in Begait and Rutanna sheep populations. Mean Arado sheep flock size is similar with Abebe *et al*. (2020) survey report on indigenous sheep in the Northwest highlands of Ethiopia (10.21±4.79) whilst the current mean flock size of Rutanna sheep is similar with Abdalla (2018) survey report on *Watish* Sheep in Singa locality, Sinnar State, Sudan (219.42±136.45). The mean flock sizes of Begait, Rutanna and Arado are not comparable with Kahsa *et al*. (2018) report on Afar sheep in Aba'ala, Afar Region, Ethiopia (27.7±20.9), Helen *et al*. (2015) report in flock size of indigenous sheep production system in Eastern Ethiopia (58.6±3.29). The difference could be due to access to grazing area, farming system of the community and purpose of breeding.

About 75% of Begait, 24% of Rutanna and 83% of Arado respondents reported that their animals went to water source to drink water. The provision of water in Begait and Rutanna respondents is not in line with Mavule (2012) report on phenotypic characterization of Zulu sheep (81.3% travel to water in winter). The differences might be due to production system and access to water on nearby area. But the provision of water in Arado respondents is in line with Mavule (2012) report on phenotypic characterization of Zulu sheep (81.3% travel to water in winter). River was the water source for the animals in about 45% of Begait and 79% of Arado respondents whilst piped water was the water source in about 46% of Rutanna respondents. The present water source is not in agreement with Fekerte (2008) survey on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (52% river as source of water), Hizkel (2017) survey in indigenous sheep of Bensa District, Southern Ethiopia (71.9% river as source of water). The difference might be due to landscape of the areas, ecology, flock size and access to many water source options.

About 60% of Begait and 58% of the Arado respondents indicated that their animals travel a distance of 1-5 kilometer (Km) to obtain water whilst the animals of 32% of Rutanna respondents drunk at household site. The present watering distance of animals in Begait and Arado respondents is in agreement with Fekerte (2008) survey report on Blackhead Somali sheep breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (61.5%). However, the present watering distance of animals in Begait and Arado respondents is not similar with Helen *et al*. (2015) report in Eastern Ethiopia (53.7%), Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (69.5% <1 km). The variation might be due to access to nearby water sources. It was also indicated that animals of 88% of Begait and 73% of Rutanna respondents drunk water once a day whereas animals in 77% of Arado respondents drunk water twice a day in the dry season. The present daily watering frequency is not similar with Fekerte (2008) survey report on Blackhead Somali sheep breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (50.0% drunk once in three days in the dry season), Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (83.6% animals drunk once a day). The difference could be due to access to water, ecological, genotype and production system.

There was no access to veterinary service center (VSC) in 72% of Begait, 41% of Rutanna and 100% of Arado respondents. The current access to VSC is not comparable with Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (96.1% accessed to VSC). This huge difference could be due to access to VSC in the study area. About 85% of Begait, 95% of Rutanna and 100% of Arado respondents travelled a distance of greater than 10 kilometers (km) to their proximity VSC. The present distance between VSC and SHFs is not comparable with Fekerte (2008) survey report on Blackhead Somali sheep breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (36.7% accessed VSC in 1 up to 5 km, 63.3% 6 up to 10 km), Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (35.15% accessed VSC in <1 km, 32.8% service in 1 up to 5 km), Helen *et al*. (2015) report in flock size of indigenous sheep production system in Eastern Ethiopia (53.7% travelled 1-5 km). The difference could be due to access to VSCs in the communities.

About 87% of Begait, 100% of Rutanna and 29% of Arado respondents used their own ram for mating. The current own ram use for mating is not in line with Abebe *et al*. (2020) report in indigenous sheep in the Northwest highlands of Ethiopia (46.2% used own ram), Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (37.7% used own ram), Hemacha *et al*. (2023) report on local sheep in selected districts of Hadiya Zone, Southern Ethiopia (72.8% no own rams). The differences could be due to flock size, purpose of breeding and production system. Ownership of ram in Arado respondents (29%) is in line with Esatu and Chencha (2022) report in Arba Minch Zuria District of Gamo Zone, Southern Ethiopia (29.7% with own ram). The sources of the rams of 63% of Begait, 81% of Rutanna and 22% of Arado respondents were born in their own flocks. The present ram birth in own flock is not similar with Abebe *et al*. (2020) report in indigenous sheep in the Northwest highlands of Ethiopia (36.8% rams born in own flock), Gedefaw and Gebremariam (2019) report in smallholder sheep production in Habru Woreda North Wollo Zone of Amhara, Ethiopia (67.5% rams born in own flock). The differences might be due to livelihood status, production system and flock sizes.

Uncontrolled mating was practiced in 54% of Begait, 22% of Rutanna and 100% of Arado respondents due to the fact that the sheep graze in communal lands. The present uncontrolled mating in all the indigenous sheep is not in agreement with Gedefaw and Gebremariam (2019) report in smallholder sheep production in Habru Woreda North Wollo Zone of Amhara, Ethiopia (85% practiced uncontrolled mating), Metsafe *et al*. (2017) report on Bonga sheep breed in Adyio Kaka District of Kafa Zone, Southern Ethiopia (96.6% practiced controlled mating), Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (72.6% practiced uncontrolled mating), Hemacha *et al*. (2023) report on local sheep in selected districts of Hadiya Zone, Southern Ethiopia (83% practiced uncontrolled mating). The differences could be due to flock size, purpose of breeding, production system, extension support and awareness of farmers. The current practice of uncontrolled mating in Arado respondents is in line with Mavule (2012) report on phenotypic characterization of Zulu sheep (100% uncontrolled mating), Abebe *et al*. (2020) survey report on indigenous sheep in the Northwest highlands of Ethiopia (100% uncontrolled mating) whereas the current practice of uncontrolled mating in Rutanna respondents is in line with Fekerte (2008) survey report on Blackhead Somali sheep breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (22.0% practiced uncontrolled mating). Unknown ram to ewe ratio was practiced in about 43% of Begait and 38% of Rutanna respondents, and 83% of the Arado respondents used a ratio of one ram to all ewes in the flock. These are not comparable with Amelmal (2022) report on Abera sheep that highest annual genetic gain (AGG) was registered in 150 candidate breeding rams at selection time (obtained from 200 ewes) and a ratio of ram to ewe of 1:27 than in different candidate numbers (50-150) and ratios of 1:9 and 1:18 in Ethiopia. The difference is due to designed breeding scheme of the Abera sheep.

The peak lambing months of Begait and Rutanna sheep were in October and November whereas the peak lambing months of Arado sheep were in September, October and November. The peak lambing months of Begait, Rutanna and Arado sheep are not in agreement with Esatu and Chencha (2022) report in Arba Minch Zuria District of Gamo Zone, Southern Ethiopia (April to May), Metsafe *et al*. (2017) report on Bonga sheep breed in Adyio Kaka District of Kafa Zone, Southern Ethiopia (May to October), Mulata *et al.* (2014) report in six selected Districts of Tigray, Northern Ethiopia

(November and December), Mengestu (2018) report on highland sheep of Tigray in Atsbi Wenberta District, Tigray, Ethiopia (December to January). The differences could be due to ecology, genotype, access to forage and production system.

About 10% of Begait, 35% of Rutanna and 69% of Arado respondents practiced ram castration at different ages of the animals. This is not comparable with Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (88.4% practiced ram castration), Hemacha *et al*. (2023) report on local sheep in selected districts of Hadiya Zone, Southern Ethiopia (91.4% practiced castration). The differences could be due to purpose of breeding and reason of castration. The purpose of ram castration was mainly to improve carcass quality (10% of Begait, 19% of Rutanna and 69% of Arado respondents. The present purpose of castration is not similar with Gedefaw and Gebremariam (2019) report in smallholder sheep production in Habru Woreda North Wollo Zone of Amhara, Ethiopia (30% to improve carcass quality), Esatu and Chencha (2022) report in Arba Minch Zuria District of Gamo Zone, Southern Ethiopia (95% to improve carcass quality), Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (52.1% to improve carcass quality), Hemacha *et al*. (2023) report on local sheep in selected districts of Hadiya Zone, Southern Ethiopia (70.8% to improve weight gain). The difference could be due to mutton quality and market demand. The animals were mainly castrated in 2-3 years old (9% of Begait, 16% of Rutanna and 48% of Arado respondents. This is not in agreement with Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (62.7% castrated in 1-2 years old). The difference could be due to purpose of breeding and reason for castration. Traditional castration method was practiced in 10% of Begait, 24% of Rutanna and 64% of Arado respondents. The current castration method is not comparable with Belete (2009) survey report on small ruminants at Jimma Zone, Western Ethiopia (60.2% burdizo), Esatu and Chencha (2022) report in Arba Minch Zuria District of Gamo Zone, Southern Ethiopia (34.9% in highland, 33.3% in midland and 26.8% in lowland areas practiced traditional castration), Esubalew *et al*. (2019) report in indigenous sheep in Western Amhara, Ethiopia (53.5% used traditional method). The differences might be due to extension support, access to burdizo, awareness of farmers and purpose of breeding. The current traditional castration practice in Arado respondents is similar with Hemacha *et al*. (2023) report on local sheep in selected districts of Hadiya Zone, Southern Ethiopia (69.5% practiced traditional castration method).

CONCLUSION AND RECOMMENDATION

Education level greatly affected sheep productivity in Arado respondents (50% illiterate) than in Begait (48%) and Rutanna (57%) respondents who attended lower primary school. Sheep were economically important in Begait (8.51±9.0 TLU) and Rutanna (22.31±17.1) respondents than in Arado respondents. Mean number of females greater than one-year-old and mean number of females of 6 months to one-year-old were the major proportions in the flocks of Begait, Rutanna and Arado sheep in the study area.

Animals went to water source to drink water in about 75% of Begait, 24% of Rutanna and 83% of Arado respondents. Animals travelled a distance of 1-5 kilo meter (Km) to obtain water in about 60% of Begait and 58% of the Arado respondents. It was also indicated that animals of 88% of Begait and 73% of Rutanna respondents drunk water once a day whereas animals in 77% of Arado respondents drunk water twice a day in the dry season. Dry and wet season (60% of Begait, 95% of Rutanna and 46% of Arado respondents) was the major season of occurrences of external parasites. Moreover, there was no access to veterinary service center (VSC) in 72% of Begait, 41% of Rutanna and 100% of Arado respondents. Surprisingly, about 85% of Begait, 95% of Rutanna and 100% of Arado respondents travelled a distance of greater than 10 km to their proximity VSC which negatively affected productivity.

Uncontrolled mating was practiced in 54% of Begait, 22% of Rutanna and 100% of Arado respondents due to communal grazing. About 43% of Begait and 38% of Rutanna respondents used unknown ram to ewes ratio and 83% of the Arado respondents used a ratio of one ram to all ewes in the flock which negatively affected productivity. It was also noted that 62% of Rutanna respondents practiced crossbreeding with Begait sheep. October and November were the peak lambing months of Begait and Rutanna sheep whereas September, October and November were the peak lambing months of Arado sheep. Ram castration was practiced in Begait (10%), Rutanna (35%) and Arado (69%) respondents. Ram castration was mainly

practiced to improve carcass quality (10% of Begait, 19% of Rutanna and 69% of Arado respondents). Traditional castration method was practiced in 10% of Begait, 24% of Rutanna and 64% of Arado respondents.

Education, controlled mating and breeding, castration to control inbreeding, access to nearby water source and access to VSC should be future attentions of the farmers and stakeholders.

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