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CHARACTERIZATION OF INDIGENOUS SHEEP HUSBANDRY PRACTICES IN WESTERN ZONE OF TIGRAY REGION, ETHIOPIA

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ABSTRACT

The survey was conducted before the ignition of the war in Tigray Regional State, Ethiopia (before October 2020). The objective of the survey was to characterize the husbandry practices of three indigenous sheep populations. A total of 253 sample households were randomly involved in the face-to-face interview. The Statistical Package for Social Sciences software was used for data analysis. Illiterates (34 %) and 44 % of the respondents attended lower primary school. A mean (± SD) flock size of 7.91 ± 11.4 Tropical Livestock Unit (TLU) of indigenous sheep of the three genotypes were kept under extensive husbandry practices, however, the indigenous sheep population trend was at a decreasing state (55 %) in the last ten years. There was lower mean flock size in Arado (11.72 ± 8.0) than in Begait (85.07 ± 90.1) and Rutanna (223.08 ± 170.5) sheep. The decreasing state of communal grazing area (97 %) resulted in seasonal feed scarcity (96 %) in the last five years. Hence, feed supplementation was practiced in 74 % of the respondents done in the dry season. Animals of most respondents (71 %) went to water source to drink water. It was noted that most animals drank water once a day (63 %) in the dry season. It was also noted that sheep fattening (4 %) was a neglected activity. There were sheep production challenges (100 %) and opportunities (72 %). Diseases (86 %) and external parasites (80 %) were major constraints in sheep production. However, lack of veterinary service (78 % no service) centre was a critical challenge. Practices of own ram-ewe mating (68 %), own flock born rams (51 %), uncontrolled mating (66 %), pure breeding (86 %) and use of rams outside of their flocks (79 %) were practiced in the indigenous sheep populations. Unknown ram-to-ewe ratio (26.9 %) and a ratio of one-ram-to-all-ewes in a flock (29.6 %) were practiced. Ram castration (35 %) was practiced to improve carcass quality (32 %). Feed development, shift to modern husbandry practices, access to veterinary services, indigenous sheep conservation through utilization, control of inbreeding, ram-to-ewe ratio, fattening and castration should be of future attentions of farmers and stakeholders.

Key words: characterization; castration; husbandry; indigenous sheep; population dynamics; population trends; watering

INTRODUCTION

The largest user of agricultural land in developing countries is livestock production directly through grazing of rangelands and indirectly through crop production (Thomas *et al*., 2004). Domesticated sheep develop an adaptation mechanism to different agro-climatic conditions and own unique characteristics for thousand years. Asia and Africa hosted 19 % of the more than one billion heads of global sheep population (Global sheep market, 2017). Ethiopia is a home for about fourteen traditionally recognized sheep populations, which are classified into nine genetically distinct breeds and six breed groups. The four ecological zones of Ethiopia, which include sub-alpine, wet highland, sub-humid lowland and arid lowland, are home for the fourteen traditionally recognized sheep populations (Solomon, 2008). There are many Ethiopian indigenous sheep breeds which comprise Menz, Horro, Arsi Bale, Blackhead Somali, Adal, Tukur, Simien, Farta, Gumuz, Washera/Dangila/Agew, Wollo, Rutanna, Sekota-Agew and Bonga (Sisay, 2002; Solomon and Gemeda, 2004; Workneh *et al*., 2004).

The diverse agro-ecology and climatic zones of Ethiopia enable to dwell large numbers of sheep populations. The estimated populations of sheep in the rural sedentary areas of the country are about 30.7

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million heads (CSA, 2017) and 31 million heads owned by resource poor small-scale farmers (CSA, 2018). DAGRIS (2006) and CSA (2013) reported that 75 % of the sheep populations in Ethiopia are found in mixed crop-livestock systems of the highland landscapes and ecologies, whilst 25 % of the sheep inhabit in the lowlands. Mixed crop-livestock, specialized pastoral and agro-pastoral production systems are the systems, where Ethiopian local sheep are kept (Solomon *et al*., 2010 a; b). Productivity of sheep in Ethiopia is extremely low due to several technical (genotype, feeding and animal health), institutional, environmental and infrastructural constraints (Markos, 2006). Nutrition is one of the most important factors affecting sheep performances, where consideration of availability of nutrients, type of feeding system and level of feeding affect performances of sheep (ILRI, 2008).

Some communities of Kafta Humera shifted from Begait sheep production to Rutanna sheep production. The Rutanna sheep population is a transboundary breed, which 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 to breed Rutanna sheep to Begait due to their fast growth rate and coat colour 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. Planning of genetic improvement, sustainable utilization and conservation strategies of a breed at local, national, regional and global levels are essentially based on characterization studies (FAO, 2012). However, not all Ethiopian sheep genetic resources and their husbandry practices are characterized and documented yet. For example, indigenous Begait sheep population, Rutanna sheep population and Arado sheep population were not included in the comprehensive study on the sheep resources of Ethiopia reported by Solomon (2008). The husbandry practices of Begait sheep population, Rutanna sheep population and Arado sheep population in the lowland and highland areas of Western Zone of Tigray, Ethiopia are not yet characterized. There is a need to characterize the husbandry practices of the sheep populations to develop a breed management plan for sustainable conservation through utilization of the indigenous sheep genetic resources of the study area. Therefore, the prime objective of the survey was to characterize the husbandry practices of the different indigenous sheep populations.

MATERIAL AND METHODS

Description of the study areas

The survey was carried out in Kafta Humera, Tsegede and Welkait districts of Tigray Region, Ethiopia. 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. Kafta Humera district has two agro-ecologies, which consist of 86 % lowland (*kola*) and 14 % midland (*weina dega*). The district was covered by 33 % of forestry land and 5 % of pasture/grazing land, and is characterized by an altitude of 500−1849 meters above sea level (masl), rainfall of 650−750 millimeter (mm) and temperature of 25−48 °C.

Welkait district has also two agro-ecologies which include 60 % lowland (*kola*) and 40 % midland (*weina dega*). The district had 18 % of grazing land and 19 % of forest land and is characterized by an altitude of 700-2354 masl, rainfall of 700−1800 mm and temperature of 18−25 °C. Tsegede district has three agro-ecologies, which comprise 70 % lowland (*kola*), 22 % midland (*weina dega*) and 9 % highland (*dega*). The district accounted 35 % of forest land and 22 % of grazing land and is also characterized by an altitude of 680-3008 masl, rainfall of 1200−2500 mm and temperature of 12−35 °C (Tesfay *et al*., 2019).

Participant characteristics and sampling procedures

The participants of the survey were farmers, who were involved in mixed crop-livestock production system. The animals were kept in a low input extensive production system. Some large-scale farmers were involved in Begait and Rutanna sheep respondents. Sample households were randomly selected, whereas the districts, which comprised of Kafta Humera (Begait and Rutanna sheep populations), Tsegede and Welkait (Arado sheep population) and the Kebelles were purposively selected depending on the sheep population. There were no participants who selected themselves into the sample. There was no any payment made to the households involved in the face-to-face survey interview.

Sample size and statistical analysis

Three districts which consist of Kafta Humera (Begait and Rutanna sheep populations), Tsegede and Welkait (Arado sheep population) were involved in the survey. A total of 253 households were used, where Begait (126), Rutanna (37) and Arado (90) sheep respondents involved in the face-to-face survey interview.

The Arado sheep population is also known as common Tigray highland sheep (Gebretsadik & Anal, 2014).

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. Chi-square (X^2) test and mean comparison were used to test the differences among proportions of variables, and $P < 0.05$ was the significance level stated.

RESULTS AND DISCUSSION

Sample household characteristics

Few (5 %) female headed households were involved in the face-to-face survey interview (Table 1). This is similar to Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (9 % female headed) and Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (7.05 % female headed). About one third (34 %) of the respondents were illiterate, whereas 44 % of the households interviewed attended lower primary school (Table 1). This is not comparable with Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (88 % illiterate) and Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (33.6 % primary school attendants, 18.2 % secondary school attendants).

Figure 1. Sample photo of Begait sheep (Adebay, Kafta Humera)

Figure 2. Sample photo of Rutanna sheep (May Kadra, Kafta Humera)

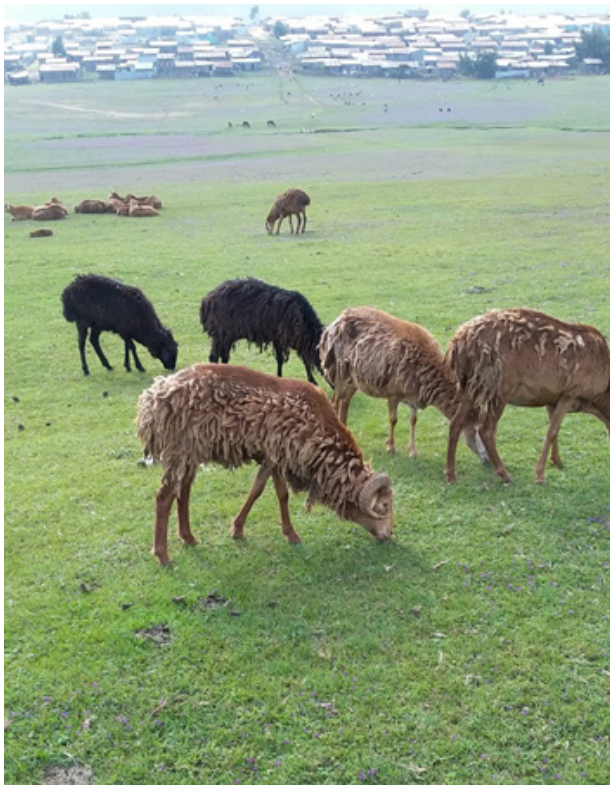

Figure 3. Sample photo of Arado sheep (Common Tigray highland sheep) (Around Ketema Nigus, Tsegede)

The differences might arise due to early access to formal education institutions and the culture of the communities. The overall mean age and family size of the respondents were 49.98 ± 10.6 years and 6.73 ± 3.1, respectively. The present mean age and family size of the respondents are similar with Fekerte (2008) survey on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (45.8 ± 14.25, 5.6). The major livestock species (TLU) in the respondents of the study area were cattle (7.89 ± 19.0), sheep (7.91 ± 11.4) and goats (3.42 ± 5.1) (Table 2). Cattle and sheep contributed greatly to the socioeconomic practices of the respondents.

Major livestock population trends

About 52 %, 55 % and 32 % of the respondents reported that population trends of cattle, sheep and goats, respectively, were at a decreasing state in the last ten years. The population trend of the indigenous sheep (55 % decreasing state of trend) is not in agreement with Mavule (2012) report on phenotypic characterization of Zulu sheep (96.9 % decrease), Fekerte (2008) survey

Table 1. Gender and educational level of respondents (n = 253)

HH head sex and educational level	Frequency (%)	X^2	*P*-value
Sex		207.277	0.000
Male	241 (95.3)		
Female	12 (4.7)		
Educational level			
Illiterate	85 (33.7)	251.524	0.000
Can only read and write	37 (14.7)		
Lower primary school	111 (44.0)		
Secondary school	15 (6.0)		
College graduated	2 (0.8)		
University graduated	2 (0.8)		

n = number of respondents

Table 2. Age, family size, household livestock and honeybee holding of respondents (Mean ± SD)

HH head age, family size and holding	Begait sheep producers (n = 126)	Rutanna sheep producers (n = 37)	Arado sheep producers (n = 90)	Overall (n = 253)	*P*-value
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
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

report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (74.3 % decrease) and Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (20.7 % decrease). The differences could be due to ecology, livelihood status, production system, access to grazing area and occurrence of disasters and diseases. It was also noted that about 57 % of the respondents reported that sheep were at a decreasing state in the last five years indicating an alarming decrease was in the last five years than in the last ten years (Table 3). The indigenous sheep populations of the study area were kept under extensive husbandry practices which greatly hampered sheep productivity.

Flock dynamics of the indigenous sheep and communal grazing area trend in 2017

The mean (± SD) number of males greater than one-year-old in Begait, Rutanna and Arado sheep were 3.40 ± 4.4, 12.16 ± 17.8 and 0.34 ± 0.6, whilst mean (± SD) number of females greater than one-year-old were 35.75 ± 54.8, 90.92 ± 76.4 and 6.00 ± 4.1, respectively (Table 4). The present mean numbers of males and females greater than one-year-old are not in line with Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (0.22 ± 0.06 males, 1.49 ± 0.09 females). The differences might be due to purpose of breeding, production system, access to grazing area, livelihood status of farmers and flock size holding. The mean (± SD) number of ram lambs born were 10.70 ± 9.4 of Begait, 28.56 ± 21.2 of Rutanna and 2.51 ± 1.5 of Arado sheep, and ewe lambs born were 17.36 ± 15.8 of Begait, 60.92 ± 61.5 of Rutanna and 2.88 ± 2.1 of Arado sheep. The ram lambs and ewe lambs born in Arado sheep are not comparable with the mean birth numbers of Begait and Rutanna lambs due to the differences in flock size holding. It was also noted that the mean (± SD) number of lamb deaths were 5.89 ± 6.7 for Begait, 23.69 ± 35.2 of Rutanna and 0.31 ± 0.9 for Arado sheep, and adult sheep deaths were 5.07 ± 5.8 for Begait, 24.50 ± 30.5 of Rutanna and 0.86 ± 1.6 for Arado sheep (Table 5). The mean numbers of lamb and adult sheep deaths for Arado and Begait in 2017 production year were not also comparable with deaths in Rutanna sheep. Mean (± SD) flock size of Arado sheep (11.72 ± 8.0) was extremely lower than Begait sheep (85.07 ± 90.1) and Rutanna sheep (223.08 ± 170.5) due to ecology,

Table 3. Population trends of indigenous cattle, sheep and goats in the last ten years (n = 253)

Status by species	Frequency (%)	X^2	*P*-value
Cattle		122.415	0.000
Increasing	50 (19.8)		
Decreasing	132 (52.2)		
Stable	10 (4.0)		
No cattle	61 (24.1)		
Sheep		117.281	0.000
Increasing	109 (43.1)		
Decreasing	139 (54.9)		
Stable	5 (2.0)		
Goats		82.067	0.000
Increasing	86 (34.0)		
Decreasing	80 (31.6)		
Stable	1 (0.4)		
No goats	86 (34.0)		
Sheep status in the last five years			
Increasing	103 (40.7)	119.107	0.000
Decreasing	144 (56.9)		
Stable	6 (2.4)		

n = number of respondents

household livelihood status, purpose of breeding and access to vast grazing areas. 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 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 respondents (96 %) reported about seasonal feed scarcity, because 97 % of the respondents indicated that the trend in communal grazing area in the last five years was at a decreasing state. Hence, 74 % of the respondents supplemented their sheep in the dry season of the year (Table 6). The current feed scarcity report (96 %) is in line with Helen *et al*. (2015) report in Eastern Ethiopia (95.2 % seasonal fluctuation in feed). The current feed supplementation practice (74 %) is not comparable with Mavule (2012) report on phenotypic characterization of Zulu sheep (76.0 % no supplement). The variations could be due to access to feed and grazing area and flock size holding of the households. Sample photos of the indigenous sheep are available. As can be observed in their sample photos, Arado sheep (Figure 3) can also be used for wool production.

Water provision method, water source, watering point distance and daily watering frequency of sheep in the dry season

Most respondents (71 %) reported that their animals went to a water source to drink water. This is not in line with Mavule (2012) report on phenotypic characterization of Zulu sheep (81.3 % travel to water

Table 4. Flock structure of indigenous sheep by age category and sex (Mean ± SD)

Population by age class	Begait sheep (n = 126)	Rutanna sheep (n = 37)	Arado sheep (n = 90)	Overall (n = 253)	*P*-value
N of male lambs <6 months old	9.27 ± 8.2	23.70 ± 19.2	1.74 ± 1.6	8.69 ± 11.8	0.000
N of female lambs <6 months old	13.09 ± 12.4	32.11 ± 28.5	2.48 ± 1.9	12.08 ± 16.9	0.000
N of males 6 months to one year old	5.00 ± 5.9	14.54 ± 19.5	0.27 ± 0.7	4.71 ± 9.7	0.000
N of females 6 months to one year old	15.26 ± 16.3	48.62 ± 48.5	0.89 ± 1.6	15.02 ± 26.7	0.000
N of males >1 year old	3.40 ± 4.4	12.16 ± 17.8	0.34 ± 0.6	3.60 ± 8.4	0.000
N of females >1 year old	35.75 ± 54.8	90.92 ± 76.4	6.00 ± 4.1	33.19 ± 55.5	0.000
N of castrated males	0.08 ± 0.7	0.92 ± 3.1	0	0.18 ± 1.3	0.000
Total N of sheep (flock size)	85.07 ± 90.1	223.08 ± 170.5	11.72 ± 8.0	79.14 ± 113.6	0.000

n = number of respondents; N = number of heads of animals; SD = standard deviation

Table 5. Entries and exits of sheep per across indigenous sheep populations in 2017 (Mean ± SD)

Entry type	Begait sheep (n = 126)	Rutanna sheep (n = 37)	Arado sheep (n = 90)	Overall (n = 253)	*P*-value
N of ram lambs born	10.70 ± 9.4	28.56 ± 21.2	2.51 ± 1.5	10.32 ± 13.4	0.000
N of ewe lambs born	17.36 ± 15.8	60.92 ± 61.5	2.88 ± 2.1	18.43 ± 31.9	0.000
N of sheep bought	0.75 ± 2.9	1.86 ± 9.9	0.21 ± 0.7	0.72 ± 4.3	0.149
Exit type					
N of lambs died	5.89 ± 6.7	23.69 ± 35.2	0.31 ± 0.9	6.44 ± 15.9	0.000
N of adult sheep died	5.07 ± 5.8	24.50 ± 30.5	0.86 ± 1.6	6.35 ± 14.4	0.000
N of sheep sold for breeding	12.27 ± 24.3	31.14 ± 62.5	2.91 ± 2.5	11.69 ± 30.6	0.000
N of sheep sold for slaughtering	4.21 ± 5.2	11.84 ± 12.2	1.73 ± 1.4	4.44 ± 6.8	0.000
N of sheep stolen	0.77 ± 2.4	1.05 ± 2.9	0	0.54 ± 2.1	0.006
N of sheep lost by predator attack	2.20 ± 4.4	2.35 ± 3.9	0.16 ± 0.7	1.49 ± 3.6	0.000

n = number of respondents; N = number of heads of animals; SD = standard deviation

in winter, 91.7 % in summer). The differences might be in the production system and access to water in nearby areas. Few (21.7 %) of the respondents reported that animals moved less than one kilometer (km) to get water in the dry season. This report (21.7 %) is not comparable with Mavule (2012) report on phenotypic characterization of Zulu sheep (45.8 % travelled to water in winter, 72.9 % in summer), where differences might be due to production system and labor status of the farmers. About 53 % of the water source for the animals was river. River as a source of water (53 %) for the animals in the dry season is in line with Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (52 % river). River, as a water source (53 %), is not similar to Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (71.9 % river as source of water). The differences could be due to ecological and geographical landscapes. About 53 % of the respondents indicated that their animals travelled a distance of 1 – 5 km to get water. Movement of animals at a distance of 1 up to 5 km (53 %) to obtain water in the dry season is not in line with Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (61.5 % travelled 1 up to 5 km in the dry season), and the present major animal watering point distance (53 %) is not comparable with Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (69.5 % travelled less than 1 km). The variations might be due to access to nearby water sources and occurrences of drought. It was also indicated that 63% of the respondents reported that their animals drank water once a day in the dry season (Table 7). The present dry season daily watering frequency (63 % drank water once a day) of Begait, Rutanna and Arado sheep is not in agreement with Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (50.0 % drank once in three days in the dry season) and Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (83.6 % animals drank once a day). The variations could be due to access to water, ecological, genotype, intensity of environmental temperature, production system and husbandry practices of the communities.

Occurrences of challenges and opportunities, diseases and external parasites in sheep production

It was noted that sheep fattening was practiced in 4 % of the respondents, which clearly neglected production activity. The present overall sheep fattening practice (4 %) is not comparable with Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (25.0 % practiced fattening). The differences might fall under access to extension support, production system, market demand and awareness of the farmers towards sheep fattening. All respondents reported the presence of challenges in sheep production. The respondents (72 %) also indicated the presence of opportunities in sheep production. Sheep disease was one of the major

Table 6. Trend in communal grazing areas in the last five years, seasonal sheep feed scarcity status and supplement practices (n = 253)

Trend in communal grazing area	Frequency (%)	X^2	*P*-value
Increasing	2 (0.80)	459.233	0.000
Decreasing	245 (96.8)		
Stable	6 (2.4)		
Seasonal feed scarcity occurrence			
Yes	243 (96.0)	214.581	0.000
No	10 (4.0)		
Feed supplement practice in dry seasons			
Yes (dry season)	186 (73.5)	200.498	0.000
Yes (dry and wet season)	60 (23.7)		
No supplement	7 (2.8)		

n = number of respondents

Table 7. How to provide water, water source type, watering point distance and watering frequency of sheep in the dry seasons (n = 253)

How to provide water	Frequency (%)	X^2	*P*-value
Animals go to water	179 (70.8)	165.470	0.000
Water is fetched	53 (20.9)		
Both types	21 (8.3)		
Water source type			
River	133 (52.6)	289.063	0.000
Water well	58 (22.9)		
Piped	29 (11.5)		
Borehole	31 (12.3)		
River and piped	1 (0.4)		
Piped and borehole	1 (0.4)		
Watering point distance			
Household site	29 (11.5)	193.937	0.000
< 1 km	55 (21.7)		
1−5 km	134 (53.0)		
6−10 km	27 (10.7)		
> 10 km	8 (3.2)		
Watering frequency			
Freely available	3 (1.2)	261.640	0.000
Once a day	159 (62.8)		
Twice a day	85 (33.6)		
Once in 3 days	6 (2.4)		

n = number of respondents

challenges in sheep production because 86 % of the respondents indicated that diseases were constraints in sheep production. About 80 % of the respondents reported that external parasites also affected sheep production. Most of the respondents (60 %) also noted that external parasites were observed in both dry and wet seasons. On the contrary, 78 % of the respondents indicated that they did not have veterinary service centres in their vicinity. Moreover, 92 % of the respondents, who got access to veterinary service centres, received service far than 10 km (Table 8). The present access to veterinary service centre is not comparable with Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (96.1 % have access to veterinary service centres). This huge difference in the availability to veterinary service centres could be due to access to veterinary service centres in the area. The present distance between Veterinary service centre and the smallholders (92 %) is not comparable with Fekerte (2008) survey report on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (36.7 % in 1 up to 5 km, 63.3 % 6 up to 10 km) and Hizkel (2017) survey report in indigenous sheep of Bensa District, Southern Ethiopia (35.15 % service in < 1 km, 32.8 % service in 1 up to 5 km). This difference is obviously due to access to veterinary service centres in the areas.

Ram source, ratio of ram to ewes and mating practices

More than half (68 %) of the respondents used their own ram for mating, and 51 % of the respondents reported that the rams were born in their own flock. Own ram-ewe mating (68 %) and own flock ram born (51 %) are not in line with Abebe *et al*. (2020) report in indigenous sheep in the Northwest highlands of Ethiopia (46.2 % own ram-ewe mating, 36.8 % ram born in own flock), Esatu and Chencha (2022) report in Arba Minch Zuria District sheep of Gamo Zone, Southern Ethiopia (29.7 % were with breeding ram) and Gedefaw and Gebremariam (2019) report in Habru Woreda North Wollo Zone of Amhara, Ethiopia (67.5 % rams born in the flock). The differences might be due

Table 8. Challenges and opportunities of sheep production, occurrence of sheep diseases and external parasites, access to vet services, type of vet service center and distance between vet service center and smallholder (n = 253)

Challenges	Frequency (%)	X^2	*P*-value
Yes	253 (100)		
Opportunities			
Yes	181 (71.5)		
No	72 (28.5)		
Frequently occurred diseases			
Yes	218 (86.2)	132.368	0.000
No	35 (13.8)		
Frequently occurred external parasites			
Yes	202 (79.8)	90.123	0.000
No	51 (20.2)		
Season of occurrence of parasites			
Dry season	50 (19.8)	81.447	0.000
Dry and wet seasons	152 (60.1)		
No ext. parasites	51 (20.2)		
Access to vet service			
Yes	57 (22.5)	76.368	0.000
No	196 (77.5)		
Type of vet service center			
Government clinic	57 (22.5)	76.368	0.000
No vet clinic	196 (77.5)		
Distance between vet service center and SHFs			
< 1 km	8 (3.2)	600.708	0.000
1−5 km	10 (4.0)		
6−10 km	3 (1.2)		
> 10 km	232 (91.7)		

SHFs = smallholder farmers**;** n = number of respondents

to livelihood status, purpose of breeding and flock sizes owned. About one third (31.6 %) of the present survey did not have their own ram for breeding, which is not in line with Abebe *et al*. (2020) report in indigenous sheep in the Northwest highlands of Ethiopia (53.8 % without breeding rams). The differences might be due to livelihood status, flock size, purpose of breeding and awareness of the farmers.

Uncontrolled mating was mainly (66 %) practiced due to the fact that most sheep graze in communal lands. Hence, 79 % of the respondents also indicated that they used rams outside of their flocks. The present uncontrolled mating (66 %) is not in agreement with Gedefaw and Gebremariam (2019) report in Habru Woreda North Wollo Zone of Amhara, Ethiopia (85 % practiced uncontrolled mating), Mavule (2012) on phenotypic characterization of Zulu sheep (100 % practiced uncontrolled mating), Fekerte (2008) survey on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (22.0 % practiced uncontrolled mating) and Metsafe *et al*. (2017) report in Adyio Kaka District sheep of Kafa Zone, Southern Ethiopia (96.6 % practiced controlled breeding). The differences could be due to differences in flock size, purpose of breeding, production system, access to grazing area, extension support and awareness of the farmers. An unknown ratio (26.9 %) of ram-to-ewes and a ratio of one-ram-to-all ewes (29.6 %) in the flock were used (Table 9). The two ratios of ram-to-ewe (26.9 % and 29.6 %) affected reproduction

Table 9. Own ram use status, breeding ram source, selection of sheep for breeding, type of mating, reason(s) for uncontrolled mating, ram use outside own flock, proportion of ram to ewes and crossbreeding practice (n = 253)

Own ram use	Frequency (%)	X^2	*P*-value
Yes	173 (68.4)	34.186	0.000
No	80 (31.6)		
Breeding ram source			
Born in flock	129 (51.0)	126.621	0.000
Bought	23 (9.1)		
Born in and bought	21 (8.3)		
No own ram	80 (31.6)		
Selection practice			
Yes	253 (100)		
No	0		
Type of mating			
Uncontrolled	166 (65.6)	24.668	0.000
Controlled	87 (34.4)		
Reason(s) for uncontrolled mating			
Community sheep graze together	166 (65.6)	24.668	0.000
Controlled	87 (34.4)		
Ram use outside own flock			
Yes	201 (79.4)		
No	52 (20.6)		
Reason(s) for ram use outside own flock			
No own ram	80 (31.6)	76.111	0.000
To get better ram	76 (30.0)		
No control	42 (16.6)		
To avoid inbreeding	3 (1.2)		
Only own ram use	52 (20.6)		
Proportion of ram to ewes			
1:21−25	42 (16.6)	132.885	0.000
1:10−20	39 (15.4)		
1:26−40	19 (7.5)		
1:Available ewes	75 (29.6)		
Unknown	68 (26.9)		
1:41−60	6 (2.4)		
1:61−100	4 (1.6)		
Crossbreeding practice			
Yes	35 (13.8)	132.368	0.000
No	218 (86.2)		

n = number of respondents

and productivity of the indigenous sheep resources in the study area. It was also noted, that 86 % of the respondents did not practice crossbreeding, which contributed to conservation of the indigenous sheep genetic resources of the area.

Ram castration practices

About 35 % of the respondents practiced ram castration at different ages of the animals mainly for the purpose of improving carcass quality (32%) of the animals and 32 % of the respondents, who practiced castration using traditional castration method (Table 10). The current practice of castration (35 %) is not in line with Esatu and Chencha (2022) report in Arba Minch Zuria District sheep of Gamo Zone, Southern Ethiopia (29.2 % practiced castration). The differences could be due to purpose of breeding, awareness and experiences of breeding and access to extension supports. The present major reason for ram castration practice which targeted to improve carcass quality (32 %) is similar to Gedefaw and Gebremariam (2019) report in Habru Woreda North Wollo Zone of Amhara, Ethiopia (30 % to improve meat quality). The current castration method (2.4 % used burdizzo) in indigenous sheep of the study area is not similar with Belete (2009) survey report on small ruminants at Jimma Zone, Western Ethiopia (60.2 % used burdizzo) and Esatu and Chencha (2022) report on Arba Minch Zuria District sheep of Gamo Zone, Southern Ethiopia (8 % used burdizzo). The differences might be due to access to burdizzo, access to extension support and awareness of farmers.

CONCLUSION AND RECOMMENDATIONS

The Begait and Rutanna indigenous sheep are well adapted to the harsh environmental conditions of arid lowland Western Zone areas of Tigray, Ethiopia. The indigenous sheep populations were kept under extensive husbandry practices. Sheep (7.91 ± 11.4 TLU) greatly contributed to the economy of rural households in the study area. However, it was noted that the indigenous sheep (55 %) were at a decreasing state in the last ten years due to different challenges.

Seasonal feed scarcity (96 %), diseases (86 %) and external parasites (80 %) were the critical challenges in sheep production in the study area. However, about 78 % of the respondents did not have access to veterinary service centres in their vicinity area. About 63 % of the respondents reported that their animals drank water once a day in the dry season revealing negative effect on productivity of the indigenous sheep. Sheep fattening (4 %) was an ignored practice, which reflects poor awareness of the communities in the study area.

Frequent own ram-ewe mating (68 %) could result in inbreeding depression due to the practice of uncontrolled mating (66 %). The use of rams outside of their flocks (79 %) could also introduce undesirable traits to the flocks because of uncontrolled mating of

Table 10. Ram castration practice, reason(s) for castration, castration age, method of castration used (n = 253)

Ram castration practice	Frequency (%)	X^2	*P*-value
Yes	88 (34.8)	23.435	0.000
No	165 (65.2)		
Reason(s) for castration			
Control inbreeding	7 (2.8)	148.206	0.000
Improve carcass quality	81 (32.0)		
No castration	165 (65.2)		
Castration age			
3−6 months	5 (2.0)	243.111	0.000
2−3 years	60 (23.7)		
4−5 years	23 (9.1)		
No castration	165 (65.2)		
Method of castration used			
Burdizzo	6 (2.4)	279.253	0.000
Traditional	80 (31.6)		
Traditional and burdizzo	2 (0.8)		
No castration	165 (65.2)		

n = number of respondents

the flocks (66 %). Reproductive and productive performances of some flocks were affected due to the use of unknown ratio of ram-to-ewe (26.9 %) and one-ram-to-all ewes ratio in the flock (29.6 %). The practice of pure breeding (86 %) was relevant in the study area, which contributed to conservation of the indigenous sheep populations. Ram castration was very poor practice (35 %) in controlling inbreeding in the flocks but focused mainly on improving carcass quality of the animals (32 %).

Feed development, shift to modern husbandry practices, access to veterinary service centres, indigenous sheep conservation through utilization, control of inbreeding, ram-to-ewes ratio, fattening and castration should be of future attentions of farmers and stakeholders.

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DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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