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Characterization of Indigenous Goat Husbandry Practices in Northwestern and Western Zones of Tigray Region, Ethiopia

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ABSTRACT

The survey was conducted before the ignition (before October 2020) of the war in Tigray Regional State, Ethiopia. Goats are concentrated in the lowland areas of Ethiopia. Goats are multifunctional for the resource-poor-farmers of Ethiopia. The objective of the survey was to characterize the husbandry practices of indigenous goat populations. Statistical Package for Social Sciences (SPSS) software was used for data analysis. Questionnaire based interview was made in randomly selected (n=389) respondents of Begait, Hassan and Arado goats. Illiterate (45%) whilst 30% of the respondents attended lower primary school. Major livestock species holdings (TLU) were cattle (7.16±9.6), goats (3.63±3.9) and sheep (2.59±5.9). However, population trends of cattle (61%), sheep (29%) and goats (62%) were at decreasing state in the last ten years. Seasonal feed scarcity (78%) was critical problem because communal browsing area trend was at decreasing state (96%) in the last five years. Hence, dry season supplementation was practiced in 60% of the respondents. Water delivery method, water source, watering point distance and watering frequency per day in dry season were highly significant different (P<0.05). Goats go to water source (85%), and river (61%) was main water source. Goats travel a distance of 1 up to 5 Kilometers to water sources (54%), and goats drink water once a day during the dry season in 65% of the respondents. Respondents reported production opportunities (62%) and challenges (3%). Diseases (83%) and external parasites (87%) were major challenges, and external parasites affected (54%) goats in both dry and wet seasons. There was no veterinary clinic service in 74% of the respondents. Own buck-doe mating used (68%), and own flock born bucks were in 59% of the respondents. Uncontrolled mating practiced (77%) due to communal browsing, and neighbor bucks used in 83% of the respondents. There was highly significant difference (P<0.05) in ratio of buck to does used. Unknown buck to does ratio used in 25% of the respondents, and one buck to all does in the flock used in 32% of the respondents. No crossbreeding was practiced in 82% of the respondents. Buck castration was practiced (57%) to improve carcass quality (39%). Feed improvement strategy options, access to water and veterinary clinic services, goat fattening, and controlled mating options should be the focus of the farmers and stakeholders.

Keywords: Characterization; Indigenous goat; Husbandry practices; Education level; Water source; Goat fattening; Communal browsing area; Castration; Population dynamics; Trend.

1. Introduction

Goats adapt to extreme temperatures, undernourishment, high altitudes, long walking distances, and long periods of drought [1],[2]. Ethiopian indigenous goat populations have developed certain valuable genetic traits such as ability to perform better under low input condition and climatic stress, tolerance to infectious diseases and parasites as well as heat stresses [3],[4]. The largest number of goats are hosted in Asia (55.45%) followed by Africa (38.66%) of the global goat population [5]. Large numbers of goat populations dwell in the diverse agro-ecology and climatic zones of Ethiopia. The rural sedentary areas of Ethiopia were hosts for about 30.2 million [6] and 32.74 million heads of goats [7]. Analysis of 15 microsatellite loci identified eight separate goat genetic entities which comprised of Arsi-Bale, Gumez, Keffa, Woyto-Guji, Abergalle, Afar, Highland goats, and eastern and south eastern goats [8]. Approximately 27% of goat population size of Ethiopia were found in crop-livestock mixed farms in the highlands whilst 73% usually inhabit in arid and semi-arid lowland areas. Ethiopian indigenous goats are genetically less productive as compared to temperate breeds [9].

Goats are valuable for nutrition and income, and major farming activity on vast areas of natural grasslands in regions where crop production is impracticable [10]. Ethiopia ranked highest in goat population both in the African continent and the global level [11]. Most indigenous goats are kept in small-scale traditional production systems in communal areas [12]. Almost all of the goat populations in Ethiopia are managed by resource poor smallholder

farmers and pastoralists under traditional and extensive production systems [13]. Goats are widespread and important to economic and social livelihoods of Ethiopian smallholder farmers, pastoralists and agro-pastoralists [14]. Smallholder farmers in Ethiopia produce goats mainly as sources of income to meet urgent cash needs. They also raise goats for meat, manure and occasionally milk; households sometimes slaughter goats for their own consumption [15]. Ethiopian farmers/pastoralists kept goats for food, income generation, socio-cultural considerations and source of other valuable non-food products such as skin and manure [16], [17], [18]. However, slow growth rates of goats managed under smallholder conditions, high mortality rate and low commercial off-take rate were the major challenges of smallholder goat production in Ethiopia [13],[19].

Though Ethiopia has large population of goats and goats have multifunctional roles, the productivity and the contribution of goat to the country economy is far below the potential [20]. Technical, institutional and socio-economic aspects were the different problems for the low productivity of goats in Ethiopia [21]. Factors such as poor nutrition, prevalence of diseases, lack of appropriate breeding strategies and poor understanding of the production system may be the factors for low productivity of goats [22]. Therefore, updating and understanding of husbandry practices of livestock species in general and breeds in particular is essential for their planned management, breeding and production. Characterization studies are essential for planning improvement, sustainable utilization and conservation strategies of a breed at local, national, regional and global levels [23]. There are some attempts of Begait goat characterizations [24],[25].

However, comprehensive goat resources study on the husbandry practices of indigenous goat populations is not available. The husbandry practices of Begait goat population, Hassan goat population and Arado goat population in the lowland areas of North-western and Western Zones of Tigray, Ethiopia are not characterized and documented. There is a need to characterize the husbandry practices of the goat populations to develop a breed management plan. Hence, the prime objective of the survey was to characterize the husbandry practices of the indigenous goat populations.

2. Materials and Methods

2.1. Description of the Study Areas

The survey was carried out in Tahtay Adiabo, Kafta Humera, Tsegede and Welkait districts. 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 Regional State. Tahtay Adiabo district is located in the Northwestern Zone of Tigray, Ethiopia. Kafta Humera district has two agro-ecologies which consist of 86% lowland (kola) and 14% midland (weina dega). Welkait district has also two agro-ecologies which include 60% lowland (kola) and 40% midland (weina dega). Tsegede district has three agro-ecologies which comprise 70% lowland (kola), 22% midland (weina dega) and 9% high land (dega). Kafta Humera district is characterized by an altitude of 500-1849 meter above sea level (masl), rainfall of 650-750 millimeter (mm) and temperature of 25-48^{o}C. Welkait district is characterized by an altitude of 700-2354 masl, rainfall of 700-1800 mm, temperature of 18-25^{o}C. Tsegede district is also characterized by an altitude of 680-3008 masl, rainfall of 1200-2500 mm and temperature of 12-35^{o}C [26]. Moreover, Kafta Humera district was covered by 33% of forestry land and 5% of pasture land/grazing land, Welkait

district had 18% of grazing land and 19% of forest land whilst Tsegede district accounted 35% of forest land and 22% of grazing land [26].

2.2. Data collection and data analysis

2.2.1. Sample size and sampling techniques

A total of 389 households of Begait (102), Hassan (106) and Arado (181) goat respondents were used for the face-to-face survey interview. However, Tahtay Adiabo (Begait) Kafta Humera (interchangeable naming: Hassan and Begait), Tsegede and Welkait (Arado: highland goats) districts and the Kebelles were purposively selected. Hence, their phenotypic observations and differences obliged to take Begait (102) and Hassan (106) goat populations as independent samples.

2.2.2. Method of data analysis

Statistical Package for Social Sciences [27] 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 was used to test the differences among proportions of variables, and at $P<0.05$ was the significance level stated.

3. Results

3.1. Household (HH) characteristics

Few (7%) female households were involved in the face-to-face interview. Education level of the respondents was significantly different ($P<0.05$). About 45% of the respondents were illiterate whereas 30% of the households interviewed attended lower primary school (Table 1). The mean age and family size of the respondents were 47.33±11.2 years and 6.58±2.1, respectively. Mean arable landholding cultivated under rain-fed condition of the respondents was 8.65±38.6 hectare (ha) whereas irrigation landholding was very low (0.09±0.6 ha). The largest population of livestock species (TLU) in the respondents were cattle (7.16±9.6), goats (3.63±3.9) and sheep (2.59±5.9) (Table 2). However, 61%, 29% and 62% of the respondents reported that population trends of cattle, sheep and goats, respectively were at a decreasing state in the last ten years (Table 3).

Table 1. Gender and educational level (n=389)

HH head sex and educational level	Frequency (%)	X^2	*P* value
Sex		285.062	0.000
Male	361(92.8)		
Female	28(7.2)		
Educational level			
Illiterate	173(44.5)	377.411	0.000
Can only read and write	75(19.3)		
Lower primary school	117(30.1)		

Secondary school	21(5.4)		
College graduated	2(0.5)		
University graduated	1(0.3)		

Table 2. HH head age, family size, household livestock and honeybee holding (mean±SD)

HH head age and family size	**Begait goat producers (n=102)**	**Hassan goat producers (n=106)**	**Arado goat producers (n=181)**	**Overall (n=389)**
Age	46.00±11.3	50.00±10.4	46.58±11.3	47.33±11.2
Family size	6.54±2.1	6.51±2.3	6.64±2.1	6.58±2.1
Landholding (ha)				
Arable landholding	2.33±1.4	27.37±70.7	1.24±1.8	8.65±38.6
Irrigation landholding	0.05±0.2	0.25±1.1	0.01±0.09	0.09±0.6
Grazing landholding	0.03±0.2	1.88±8.1	0.02±0.1	0.53±4.3
Livestock and honey bee				
Cattle holding (TLU)	10.19±9.1	8.34±14.9	4.77±3.2	7.16±9.6
Sheep holding (TLU)	0.75±1.1	8.52±9.1	0.16±0.4	2.59±5.9
Goats holding (TLU)	4.30±2.8	7.03±5.3	1.27±0.9	3.63±3.9
Begait goats (TLU)				4.30±2.8
Hassan goats (TLU)				7.03±5.3
Arado goats (TLU)				1.27±0.9
Chickens holding (TLU)	0.07±0.1	0.09±0.1	0.04±0.1	0.06±0.1
Donkeys holding (TLU)	0.73±0.9	0.61±0.8	0.51±0.4	0.59±0.7
Camels holding (TLU)	0.31±0.5	0.01±0.1	0.02±0.1	0.09±0.3
Honeybees holding (number)	0.08±0.3	0	0.78±1.5	0.38±1.1
Mules holding (TLU)	0	0	0.1±0.1	0.01±0.1
Horse holding (TLU)	0	0	0.11±0.4	0.05±0.3

n=number of respondents

Table 3. Population trend of major livestock species in the last ten years (n=389)

Status by species	**Frequency (%)**	**X^2**	***P* value**
Cattle		309.828	0.000
Increasing	97(24.9)		
Decreasing	238(61.2)		
Stable	12(3.1)		
No cattle	42(10.8)		
Sheep		179.031	0.000
Increasing	81(20.8)		
Decreasing	112(28.8)		
Stable	6(1.5)		
No sheep	190(48.8)		
Goats		216.823	0.000
Increasing	143(36.8)		
Decreasing	241(62.0)		
Stable	5(1.3)		

3.2. Goat population dynamics in 2017, and trend in communal grazing land

The mean number of males greater than one-year-old in Begait, Hassan and Arado goats were 2.16±1.9, 2.97±3.0 and 0.57±0.9 whilst mean number of females greater than one-year-old were 14.79±12.8, 25.21±21.7 and 5.99±4.9, respectively (Table 4). Mean number of buck and doe kids born were (8.29±7.9, 11.42±12.2 and 2.62±2.8) and (9.93±9.3, 18.02±16.3 and 4.14±4.0) whilst the mean number of kids and adult goat deaths were (5.59±7.9, 5.89±11.3 and 1.13±2.8) and (4.46±7.3, 6.29±11.6 and 1.27±2.7) for Begait, Hassan and Arado goats, respectively (Table 5). The respondents (78%) reported that there was seasonal feed scarcity because 96% of the respondents indicated that the trend in communal grazing area in the last five years was at a decreasing state. Hence, 60% of the respondents supplemented their goats in the dry season of the year (Table 6).

Table 4. Goat flock structure by age class, sex and goat populations (mean±SD)

Class by age and sex	**Begait goat producers (n=102)**	**Hassan goat producers (n=106)**	**Arado goat producers (n=181)**	**Overall (n=389)**
N of male kids <6 months old	6.33±4.9	9.04±9.1	1.73±1.5	4.90±6.3

N of female kids <6 months old	6.90±5.7	11.47±10.5	2.29±1.8	5.97±7.4
N of males 6 months to one year old	3.78±4.1	5.38±6.8	0.73±1.7	2.78±4.7
N of females 6 months to one year old	8.75±7.8	14.34±12.3	1.34±2.2	6.78±9.4
N of males >1 year old	2.16±1.9	2.97±3.0	0.57±0.9	1.63±2.2
N of females >1 year old	14.79±12.8	25.21±21.7	5.99±4.9	13.46±15.6
N of castrated males	0.40±0.9	0.21±0.8	0.06±0.4	0.19±0.7
Total n of goats/owner	43.02±28.1	70.29±52.6	12.65±9.9	36.30±39.9

n*=number of respondents, N=Number of heads of animals, SD=Standard Deviation

Table 5. Entries and exits of goats per each flock across goat populations in 2017 (Mean±SD)

Entry type	**Begait goat producers (n=102)**	**Hassan goat producers (n=106)**	**Arado goat producers (n=181)**	**Overall (n=389)**
N of buck kids born	8.29±7.9	11.42±12.2	2.62±2.8	6.47±8.6
N of doe kids born	9.93±9.3	18.02±16.3	4.14±4.0	9.37±11.6
N of goats bought	0.20±0.7	1.18±5.9	0.38±1.4	0.55±3.3
N of goats donated		0.03±0.3		0.01±0.15
N of goats from dowry				0
N of goats exchanged				0.02±0.17
Exit type				
N of kids died	5.59±7.9	5.89±11.3	1.13±2.8	3.59±7.7
N of adult goats died	4.46±7.3	6.29±11.6	1.27±2.7	3.46±7.6
N of goats sold for breeding	6.87±10.4	11.33±18.2	3.15±5.2	6.35±11.9
N of goats sold for slaughtering	3.52±3.2	4.24±4.9	1.83±1.9	2.93±3.5
N of goats stolen	1.81±9.9	0.83±2.7	0.35±0.9	0.87±5.4
N of goats lost by predator attack	3.03±4.8	1.45±2.8	1.54±2.2	1.91±3.3

Table 6. Trend in communal grazing areas in the last five years, seasonal sheep feed scarcity status and supplement practices (n=389)

Trend in communal grazing area	**Frequency (%)**	**X^2**	***P* value**
Increasing	3(0.8)	696.514	0.000
Decreasing	375(96.4)		
Stable	11(2.8)		
Seasonal feed scarcity occurrence			
Yes	303(77.9)	121.051	0.000
No	86(22.1)		
Feed supplement practice in dry seasons			
Yes	234(60.2)	16.044	0.000
No supplement	155(39.8)		

3.3. Water provision method, water source, watering point distance and watering frequency/day of goats in the dry season

There were highly significant differences ($P<0.05$) in water provision method, water source, watering point distance and watering frequency per day of goats in the dry season. Most respondents (85%) reported that their animals go to water source to get water. About 61% of the water source for the animals was river. Majority (54%) of the respondents indicated that their animals travel a distance of 1 up to 5 Kilometers (Km) to obtain water. It was also indicated that 65% of the respondents reported that their goats drink water once a day during the dry season (Table 7).

Table 7. How to provide water, water source type, watering point distance and watering frequency of goats in the dry seasons (n=389)

How to provide water	**Frequency (%)**	**X^2**	***P* value**
Animals go to water	331(85.1)	468.977	0.000
Water is fetched	27(6.9)		
Both types	31(8.0)		
Water source type			
River	237(60.9)	309.416	0.000
Water well	50(12.9)		

Piped	6(1.5)		
Borehole	96(24.7)		
Watering point distance			
Household site	22(5.7)		
<1 Km	125(32.1)		
1-5 Km	208(53.5)	387.362	0.000
6-10 Km	32(8.2)		
>10 Km	2(0.5)		
Watering frequency			
Freely available	4(1.0)		
Once a day	251(64.5)		
Twice a day	126(32.4)	422.897	0.000
Once in 3 days	8(2.1)		

3.4. Challenges and opportunities and occurrences of diseases and external parasites in goat production

Only 3% of the respondents reported that there were challenges in goat production. Most of the respondents (62%) also indicated that there were opportunities in goat production. Goat disease was one of the major challenges in goat production because 83% of the respondents indicated that diseases were constraints in goat production. External parasites also affected goat production because about 87% of the respondents reported that goats were infested by external parasites. Above half of the respondents (54%) also noted that external parasites were observed in both dry and wet seasons. However, 74% of the respondents indicated that they did not have veterinary clinics in their vicinity area. Moreover, 11% of the respondents who got access to veterinary clinics received service at a distance in greater than 10 Km (Table 8).

Table 8. Challenges and opportunities of goat production, occurrence of goat diseases and external parasites, access to vet services, type of vet service center and distance between vet service center and smallholder (n=389)

Challenges	**Frequency (%)**	**X^2**	***P* value**
Yes	379(97.4)	350.028	0.000
No	10(2.6)		
Opportunities			
Yes	242(62.2)	23.201	0.000
No	147(37.8)		

Frequently occurred diseases			
Yes	324(83.3)	172.445	0.000
No	65(16.7)		
Frequently occurred external parasites			
Yes	339(87.1)	214.707	0.000
No	50(12.9)		
Season of occurrence of parasites			
Dry season	120(30.8)	239.082	0.000
Wet season	9(2.3)		
Dry and wet seasons	210(54.0)		
No ext. parasites	50(12.9)		
Access to vet service			
Yes	103(26.5)	86.090	0.000
No	286(73.5)		
Type of vet service center			
Government clinic	103(26.5)	86.090	0.000
No vet clinic	286(73.5)		
Distance between vet service center and SHFs			
<1 Km	26(6.7)	702.375	0.000
1-5 Km	23(5.9)		
6-10 Km	12(3.1)		
>10 Km	42(10.8)		
No access	286(73.5)		

3.5. Buck source, proportion of buck to does and mating practices

Most of the respondents (68%) used their own buck for mating, and 59% of the respondents reported that the bucks were born in their own flock. Uncontrolled mating was mainly (77%) practiced due to the fact that most goats graze in communal lands. Hence, 83% of the respondents also indicated that they used bucks outside of their flocks. There was highly significant difference (P<0.05) in ratio of buck to does. One fourth of the mating ratio of buck to does were unknown ratio (25%), and a ratio of one buck to available does (32%) was practiced. It was also noted that

82% of the respondents did not practice crossbreeding (Table 9). Only one percent of the indigenous goat respondents (n=389) interviewed practiced goat fattening. The cycle of fattening per year was also below the standard of fattening. The marketable ages (months) of male Begait, Hassan and Arado goats were 7.73±3.1, 6.43±1.9 and 7.56±2.6. There were highly significantly differences (P<0.05) in buck castration practice, reason(s) for castration, castration age, method of castration used. Only 57% of the respondents practiced buck castration at different ages of the animals mainly (39%) for the purpose of improving carcass quality of the animals, and 54% of the respondents who practiced castration used traditional castration method (Table 10).

Table 9. Own buck use status, breeding buck source, selection of goat for breeding, prevention of mating of related animals, type of mating, reason(s) for uncontrolled mating, buck use outside own flock, ratio of buck to does and crossbreeding practice (n=389)

Own buck use for mating	**Frequency (%)**	**X^2**	***P* value**
Yes	264(67.9)	49.668	0.000
No	125(32.1)		
Breeding buck sources			
Born in flock	230(59.1)	321.756	0.000
Bought	14(3.6)		
Born in and bought	20(5.1)		
No own buck	125(32.1)		
Selection practice			
Yes	389(100)		
No	0		
Type of mating			
Uncontrolled	298(76.6)	110.152	0.000
Controlled	91(23.4)		
Reason(s) for uncontrolled mating			
Community goat graze together	298(76.6)	110.152	0.000
Controlled	91(23.4)		
Buck use outside own flock			
Yes	324(83.3)		
No	65(16.7)		

Ratio of buck to does			
1:21-25	51(13.1)	247.532	0.000
1:10-20	86(22.1)		
1:26-40	14(3.6)		
1:Available does (all does in the flock)	124(31.9)		
Unknown ratio	98(25.2)		
1:41-60	14(3.6)		
1:61-100	2(0.5)		
Crossbreeding practice			
Yes	69(17.7)	161.956	0.000
No	320(82.3)		

Table 10. Buck castration practice, reason(s) for castration, castration age, method of castration used (n=389)

Buck castration practice	**Frequency (%)**	**X^2**	***P* value**
Yes	223(57.3)	8.352	0.004
No	166(42.7)		
Reason(s) for castration			
Control inbreeding	3(0.8)	177.859	0.000
Improve carcass quality	151(38.8)		
Control inbreeding and improve carcass quality	69(17.7)		
No castration	166(42.7)		
Castration age			
3-6 months	1(0.3)	510.954	0.000
2-3 years	173(44.5)		
4-5 years	22(5.7)		
No castration	166(42.7)		
3-6 months and 2-3 years	16(4.1)		
2-3 and 4-5 years	11(2.8)		

Method of castration used			
Burdizzo	6(1.5)	344.542	0.000
Traditional	209(53.7)		
Traditional and burdizzo	8(2.1)		
No castration	166(42.7)		

4. Discussions

Very few (7%) female households were involved in the face-to-face survey interview. Male headed households mainly involved in goat rearing in the study area, and is in agreement with [28] male headed households (92.2%) survey report in Nuer Zone, South Western Ethiopia, [29] survey report male headed households at Bati (93.9%), Ethiopia. Education level of the Begait, Hassan and Arado goat respondents was very poor in which about 45% of the respondents were illiterate whereas 30% of the households interviewed attended lower primary school. Illiterate respondents (45%) of the Begait, Hassan and Arado is in line with the study conducted at Shabelle Zone (42%) reported by [30], [31] survey report (45.6% illiterate) in Western Zone of Tigray, Ethiopia but not similar with [28] survey report (71.11% illiterate) in Nuer Zone, South Western Ethiopia. The differences may be due to cultural effects and access to education institutions.

Cattle (7.16±9.6 TLU) and goats (3.63±3.9 TLU) were the major livestock species in the study area. However, cattle (61%) and goats (62%) were at a decreasing state in the last ten years. The present population trend in cattle is in line with the work of [32] in Begait cattle (65% large farms, 71% small farms of decreases). But the current population trend of goats (62%) is not in line with [33] work on phenotypic characterization of Zulu sheep (95.8% decrease), [30] goat study report at Shabelle Zone (74% increasing trend). The differences could be due to ecology, livelihood status, disasters and diseases, and other production challenges. The present goat population trend (62%) is in line with [34] survey on Blackhead Somali Sheep Breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (57.8% decreasing).

There were mean (±SD) flock sizes of 43.02±28.1 Begait, 70.29±52.6 Hassan and 12.65±9.9 Arado goats per household. There is similarity in mean flock size of Arado goat and mean flock sizes in [35] work at Lay Armachiho (10.5±7.5), [36] work at Bati area (8.99±0.59). There is similarity in mean flock size of Begait and mean flock size of Siti area (44.02±3.33) [36] report but mean flock sizes of Begait and Hassan goats are higher than the mean flock sizes in Ziquala (36.1±61.9) and Tanqua Abergelle (38.2±63.9) reported by [35] and in [36] report at Borana (23.08±1.94). This variation could be due to purpose of breeding, access to vast browsing area and community livelihood status. In the population dynamics, mean number of males greater than one-year-old was very low due to early slaughter and sale of the males in the study area. Moreover, mean number of kid and adult deaths of Arado goats was lower than the deaths in Begait and Hassan goats due to the existence of ecological and occurrence of diseases and disaster differences in the populations. The ecology of Begait and Hassan goats is arid lowland of Northwestern and Western Zones of whereas that of Arado goat is the sub-humid lowland of Western Zone of Tigray, Ethiopia.

Seasonal feed scarcity was critical in 78% of Begait, Hassan and Arado respondents because 96% of the respondents indicated that the trend in communal browsing area in the last five years was at a decreasing state. The trend in communal browsing area is not in agreement with the survey at Shabelle Zone (14% decreasing trend) reported by [30] could be due to differences in expansion of cultivations and extent of deforestations practices in the communities. Most (60%) of the Begait, Hassan and Arado respondents supplemented their goats in the dry season. This current supplementation practice is similar with [29] survey report at Bati area (55.1%), Ethiopia. Most respondents (85%) reported that their animals go to water source. River was the main water source for about 61% of Begait, Hassan and Arado respondents in the dry season. This is not in line with the work in Ziquala (92.6%), Tanqua Abergelle (82.9%) and Lay Armachiho (95.8%) reported by [35], survey at Shabelle Zone of Denan (0%), Gode (90.5%) and Adadle (50%) reported by [30], [28] report on river (71.7%) survey in Nuer Zone, South Western Ethiopia. The differences could be due to geographical topographic features, ecological and access to natural resources. Goats of 54% of Begait, Hassan and Arado respondents travel a watering point distance of 1 up to 5 Kilometers (Km) to obtain water in the dry season. This is not in line with the work in Ziquala (79.4%), Tanqua Abergelle (67.1%) and Lay Armachiho (66.1%) reported by [35], survey at Shabelle Zone of Gode and Adadle and Denan of all levels of distances reported by [30]. The differences could be due to geographical topographic features, manmade water structures, ecological and access to nearby water resources.

The goats of 65% of Begait, Hassan and Arado respondents drank water once a day during the dry season. Once a day drinking of water in areas with extreme environmental temperature (maximum of 48℃) reveal direct negative effect on goat productivity. The current daily watering frequency (65%) is similar with the survey at Shabelle Zone of Denan (66.7%) but not similar with Gode (33.3%) and Adadle (78.6%) reported by [30]. The variations may be due to in access to water, ecological, environmental temperature, and breeding experiences of farmers. The daily watering frequency in the study area of dry season (65%) is not also in line with the work in Ziquala (97.1%) and Tanqua Abergelle (88.6%) reported by [35], [36] report in Bati area (93.9%), Borana (2.3%) and Siti area (30.4%) but similar with Lay Armachiho (65.3%) of North Gondar Zone, Ethiopia.

One percent of the Begait, Hassan and Arado respondents practiced goat fattening which is economically meaningless. Production opportunities (62%) were favorable inputs to the productivity of indigenous goats. Diseases (83%) as constraints in goat production in the study area does not agree with [28] survey report on diseases prevalence (43.9%) in Nuer Zone, South Western Ethiopia may be due to differences in access to veterinary service, environmental temperature and ecological advantage. External parasites (87%) also affected goat production. This is similar with [32] survey report on Begait cattle (large farms (96.8%) and small scale (96.6%) farms) that the lowland area of Western Tigray, Ethiopia is favorable ecology for the survival of external parasites. Lack of access to veterinary clinics in their vicinity area (74%) also greatly affected goat productivity in the study area.

Own buck-doe mating was practiced in 68% of Begait, Hassan and Arado respondents. This is in agreement with [36] report in Borana (64.4%) but not similar with [31] survey report no own buck (67.2%) in Western Zone of Tigray, Ethiopia and the variation may be due to increased awareness in having own buck across time. Uncontrolled mating (77%) was practiced in Begait, Hassan and Arado goat respondents due to the fact that most goats browse in communal lands. This is not in line with [36] report in Bati area (88.8%), Borana (98.5%) and Siti area (98.3%)

practiced uncontrolled mating, [30] survey report at Shabelle Zone of Gode (66.7%), Denan (66.7%) and Adadle (62%) practiced controlled mating, [31] survey report (51.1% uncontrolled mating) in Western Zone of Tigray, Ethiopia. The differences may be due to access to own buck, awareness and breeding experiences of farmers. But the current uncontrolled mating (77%) practice is in line with [28] survey work (81.1% uncontrolled mating) in Nuer Zone, South Western Ethiopia. Most (83%) of Begait, Hassan and Arado goat respondents also indicated that they used bucks outside of their flocks. This is not in line with [36] work at Bati area (50.0%), Borana (35.6%) and Siti area (16.5%) used bucks outside of their flocks, [30] work at Shabelle Zone goat all (100%) goat respondents with their own buck. The differences may be due to browsing system, access to buck, training and education and livelihood status of the communities.

About one third (32%) of Begait, Hassan and Arado goat respondents used a ratio of one buck to all does in the flock, and unknown buck to doe ratio was practiced in 25% of the respondents. Both ratios affected the reproductive and productive performances of goats. Crossbreeding was not a practice in 82% of the respondents which moderately conserved the gene pool of the indigenous goat populations in the study area. Buck castration practiced (57%) at different ages of the animals to improve carcass quality (39%), and traditional castration method (54%) was the major practice of the study area. The current practice of castration (57%) is incomparable with the survey at Shabelle Zone (93.7%) practiced castration for improved fattening (77.8%), control breeding (19%) and better temperament (3.2%) reported by [30], [28] survey report (85.6% no buck castration practice) in Nuer Zone, South Western Ethiopia, [31] survey report (60.0% no buck castration) in Western Zone of Tigray, Ethiopia, [37] survey report (89.3% practice buck castration) in Nyangatom and Malle pastoral and agro-pastoral districts of SNNPR, Ethiopia. The differences may be livelihood status, availability of bucks, awareness and breeding experiences of farmers. Method of castration used at Shabelle Zone was Burdizzo (61.9%) reported by [30] is not similar with the current traditional method of castration (54%) due to differences in training and education to create awareness, access to Burdizzo and experiences of the farmers.

5. Conclusions and Recommendations

Most of the large goat flocks are concentrated in the arid and semi-arid areas of Ethiopia. Goats are essential for the resource-poor-farmers of the country. Education level of the respondents was very poor which greatly affected goat productivity. About 47% of the respondents were Arado goat (highland goat) respondents. The population trend of indigenous goats (62%) was at a decreasing state in the last ten years due to different factors. Goats (3.63±3.9) were preceded by cattle (7.16±9.6) in the study area. In the population dynamics, mean number of males greater than one-year-old was very low due to early slaughter and sale. Moreover, mean number of kid and adult deaths of Arado goats was lower than the deaths in Begait and Hassan goats due to their ecological, disease and disaster differences.

The deforestation of browsing forages of the study area prominently affected goat productivity. Goats loss energy in search of water (animals go to water source (85%), travel a watering point distance of 1 up to 5 Kilometers (54%)) in the dry season. Once a day drinking of water (65%) in areas with extreme environmental temperature (maximum of 48℃) reveal direct negative effect on goat productivity. Goat fattening was a very poor practice (1%) in the study area due to lack of awareness of the farmers in goat fattening. Production opportunities of goat (62%) were fertile grounds and can enhance goat productivity. However, goat diseases (83%) and external parasites (87%) were

critical challenges in goat production in the study area. Lack of access to veterinary clinics in their vicinity area (74%) was a problem in the study area which hindered goat productivity of the area.

Own buck mating (68%) was practiced in the area which can result in inbreeding depression, and uncontrolled mating (77%) was practiced which can introduce undesirable traits to the flocks. Own bucks used for mating and breeding outside of their flocks (83%) which could result in introducing both desirable and undesirable traits. A ratio of one buck to all does in the flock (32%), and unknown buck to doe ratio (25%) was practiced which could affect reproductive performance of the exposed flocks. Pure breeding (82%) was practiced which is essential practice in conservation of pure breeds of the indigenous goat populations. Buck castration (57%) was practiced in the study area to improve carcass quality (39%) but castration as a practice was very poor in controlling inbreeding (0.8%) in the indigenous goats.

Due attention should be given to indigenous goat rearing because they were poorly understood genetic resources in the study area. Feed and forage improvement and development strategy options, access to water and veterinary clinic services, castration as an option to control inbreeding and controlled mating options should be the focus of the farmers and stakeholders.

Declarations

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Competing Interests Statement

The authors declare that there are no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this original research work. The manuscript has been submitted for publication with due consent of authorities of their institute.

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Ethical Statement and Conflict of interest

The original research work presented here does not involve any experiment with human or animals. The manuscript has been carried out solely by authors, and therefore there is no conflict of interest in this manuscript.

Authors' Contributions

All the authors took part in literature review, analysis, and manuscript writing.

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