e-palli

INTERNATIONAL JOURNAL OF VETERINARY MEDICINE AND ANIMAL SCIENCE (IJVMAS)

VOLUME 1 ISSUE 1 (2023)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

International Journal of Veterinary Medicine and Animal Science (IJVMAS)
Volume 1 Issue 1, Year 2024
https://journals.e-palli.com/home/index.php/ijvmas

Flock Dynamics, Production Challenges and Opportunities of Indigenous Goat and Sheep Populations in North Western and Western Zones of Tigray Region, Ethiopia

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Article Information

Received: April 08, 2024

Accepted: August 16, 2024

Published: August 20, 2024

Keywords

Flock Dynamics, Challenges, Opportunities, Indigenous, Goats, Sheep, Diseases, Parasites, Index Ranking, Economic Importance, Income Sources, Tropical Livestock Unit

ABSTRACT

The survey was conducted before the war (before October 2020) in Tigray Regional State, Ethiopia. Indigenous (102 Begait, 106 Hassan and 181 Arado) goat respondents and sheep respondents (126 Begait, 37 Rutanna and 90 Arado) were randomly involved in the head to head interview. Statistical Package for Social Sciences, index ranking and mathematical formulas were used for data analysis. The objective of this survey was to assess flock dynamics, production challenges and opportunities of indigenous goat and sheep populations. Very limited numbers of goat respondents (17% of Begait, 1% of Hassan and 6% of Arado) and sheep respondents (5% of Begait and 7% of Arado) were female headed households. Goat respondents of about 42% of Begait, 29% of Hassan and 55% of Arado were illiterate whereas 25% of Begait, 43% of Hassan and 26% of Arado goat respondents, and 48% of Begait and 57% of Rutanna sheep respondents attended lower primary school. About half (50%) of the Arado sheep respondents were illiterate. The indigenous goat (Begait, Hassan and Arado) and sheep (Begait, Rutanna and Arado) populations were kept under low input extensive production system. Economic contributions ranking of the respondents indicated that goat, cattle and sheep were ranked first, second and third in goat survey whilst sheep, goats and cattle were ranked first, second and third in sheep survey, respectively. Indigenous goat respondents reported that the first, second, and third ranked income sources of the respondents were crop production, goat production, and cattle production, whereas crop production, sheep production, and goat production were the first, second, and third ranked income sources of the indigenous sheep respondents. The major entry in all the indigenous goat and sheep in 2017 production year was additions of newborns to the flocks. Sale and death were the first and second ranked exits in indigenous goats and sheep. Except Hassan goats (+0.1%), flock dynamics (%) in entries and exits of indigenous goat and sheep flocks were at decreasing rates which greatly damaged the economy of the respondents. Begait flock (-16.5%) and Arado flock (-16.7%) goat populations were highly decreased in 2017 production year compared to indigenous sheep flock populations. Respondents of indigenous goat (92% of Begait, 99% of Hassan and 99% of Arado) and sheep (all respondents-100%) reported production challenges and negatively affected productivity. Respondents of indigenous goat (87% of Begait, 80% of Hassan and 38% of Arado) and sheep (76% of Begait, 100% of Rutanna and 53% of Arado respondents) reported production opportunities which could enhance small ruminant productivity. The first, second and third ranked challenges in the indigenous goat and sheep were rangeland scarcity, diseases and lack of veterinary services, respectively. Rangeland scarcity directly negatively affected annual reproductive rate of the indigenous goat and sheep of the study areas. The first, second and third ranked diseases in both goat and sheep were shipping fever, Coenuruses and Contagious Caprine Pleuropneumonia, respectively. The first and second ranked external parasites in both goat and sheep were ticks and fleas whilst the third ranked external parasites in goats was sore mouth and in sheep was jigger flea infestation. Therefore, the diseases, external parasites and challenges should be taken in to account in the designing of genetic improvement of the indigenous goat and sheep of the study areas. Veterinary service centers should also be accessible to all indigenous goat and sheep producers in the study areas.

INTRODUCTION

The first ruminant animal domesticated were goats (Capra hircus) which were the first animals reached Ethiopia from the North in 2000-3000 B.C. (Rege and Lebbie, 2000). Small ruminants contribute to landless, rural farming, peri-urban and increasingly to urban households by providing food, income, socio-cultural wealth and clothing (FAO, 2009). The short generation interval, high fertility, adaptation in harsh environment and ability to produce in limited feed resource are comparative advantages of goat and sheep production compared to large ruminant livestock production (Tsedeke, 2007).

Ethiopia hosted nine sheep and eight goat breeds (EBI, 2014). The low level productivity of small ruminant which substantially depend on indigenous breed and kept under mixed crop-livestock production system in different agro ecological conditions of Ethiopia (Solomon *et al.*, 2010). Feed scarcity, disease challenges and low-input

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systems are harsh environments that sheep can survive (Markos, 2006). Ethiopian goats contribute significantly to the livelihoods of resource-poor-farmers (Halima *et al.*, 2012). Goats raised mostly to safeguard against crop failure. Goat farming community sale goats and goat products (meat, skin and milk) which are major sources of cash income (Legesse, 2008).

The economic contribution of the livestock sector in Ethiopia is low due to a number of constraints (Chanyalew *et al.*, 2009). One of the major constraints of livestock production is feed shortage which is considered the cornerstone of production (EEA, 2006). Productivity of goats is low due to feed shortage and poor nutrition, prevalence of goat diseases and parasites (Belete, 2009), lack of input, predators and marketing problems (Ameha, 2008). Genetic factors, poor management, seasonal fluctuations in feed resources and diseases resulted in poor reproductive performances of Ethiopian goats and sheep (Mukasa-Mugerwa *et al.*, 2002). Small ruminant productivity did not match their national number due to the prevalence of diseases, lack of breed improvement program, shortage of feed and water, traditional production system, lack of infrastructure, long market channels, climatic conditions, and poor reproductive performance (Abera, 2021,). Moreover, Kosgey (2004) also reported low levels of management, disease and parasite, inadequate feed and poor marketing were constraints to small ruminant productivity (Kosgey, 2004). Better feed availability in terms of quantity and quality at pre-mating and during the gestation period shortens the lambing interval and increases the litter size of sheep, and overall revealed higher annual reproductive rate (ESAP, 2014).

There are many indigenous goat and sheep genetic resources in the different agro-ecological zones of Ethiopia in general and in Tigray Regional state in particular. Begait, Hassan and Arado are indigenous goat genetic resources, and indigenous sheep genetic resources comprised of Begait, Rutanna (transboundary breed) and Arado survive and reproduce in Northwestern and Western Zones of Tigray Regional state. These small ruminant genetic resources greatly contribute to the nutrition and food security of the communities of the study areas, and contribute to the national economy of the country. However, the productivity of the small ruminant genetic resources was poor due to different factors including absences of genetic improvement strategies. The small ruminant genetic resources of the study areas call for productivity improvements which depend on sustainable conservation, utilization and genetic improvement strategies. Therefore, the objective of this survey was to assess flock dynamics, production challenges and opportunities of indigenous goat and sheep populations.

MATERIALS AND METHODS

Description of the Study Areas

The goat survey was carried out in Kafta Humera, Tsegede, Welkait and Tahtay Adiabo districts whilst the sheep survey was carried out in 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. The Western Zone of Tigray is located at 570 and 991 kilometers far from Mekelle and Addis Ababa, respectively (ZOIC, 2015). The Zone also lies at 13°42' to 14°28' North latitudes and 36°23' to 37°31'East longitudes (Mekonnen *et al.*, 2011). Tahtay Adiabo district is located in the North Western Zone of Tigray Region, Ethiopia.

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

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

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

Data Collection and Statistical Analysis

Indigenous goat respondents of 102 of Begait, 106 of Hassan and 181 of Arado were randomly involved in the face-to-face questionnaire interview. However, Tahtay Adiabo (Begait) Kafta Humera (Hassan), Tsegede and Welkait (Arado: highland goats) districts were purposively selected. The Kebelles were also purposively selected for the single visit questionnaire survey. Begait (126), Rutanna (37) and Arado (90) sheep respondents which totaled 253 sample households were randomly involved in the face-to-face interview. However, Kafta Humera (Begait and Rutanna sheep populations), Tsegede and Welkait (Arado sheep population) districts and the Kebelles were purposively selected. Rutanna sheep is a transboundary breed (imported from Sudan by the two border Kebelles of Kafta Humera (May Kadra and Bereket). All the respondents of the indigenous goat and sheep practiced mixed crop-livestock production system. Shishay *et al.* (2024) in chicken survey work study area background information also confirmed that 97.7% of the respondents in Western Zone of Tigray Region practiced mixed crop-livestock production system.

Statistical Package for Social Sciences (IBM, 2019) software was used for the analysis of the demography and household livestock holdings. Index ranking (Kosgey, 2004) was also employed for ranking of different qualitative variables.

$$Index = \frac{\text{Sum(3 x R1+2 x R2+1 x R3) given for an individual rank}}{\text{Sum(3 x R1+2 x R2+1 x R3) given for all ranks}}$$

Where R1, R2 and R3 are respondents who ranked first (R1), second (R2) and third (R3).

Moreover, percent entry and exit of indigenous goat and sheep were calculated by dividing each entry or exit to the total population of goats or sheep of the respondents and multiplied by 100%. Analysis of the diseases and external parasites of the indigenous goats and sheep was a translation work of the local nomenclatures and clinical signs reported by the respondents into their common nomenclatures.

$$\text{Percent entry or exit} = \frac{\text{Entry X or Exit Y}}{\text{Total goat or sheep population in the respondents}} x\ 100\%$$

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Very limited number (17% of Begait, 1% of Hassan and 6% of Arado goat respondents and 5% of Begait and 7% of Arado sheep respondents) were female headed households who involved in the face-to-face interview (Figure 1). About 42% of Begait, 29% of Hassan and 55% of Arado goat respondents were illiterate whereas 25% of Begait, 43% of Hassan and 26% of Arado goat respondents, and 48% of Begait and 57% of Rutanna sheep respondents attended lower primary school. About half (50%) of the Arado respondents were illiterate (Figure 2).

Respondents with mean (±SD) ages of 46.00±11.3 and 51.13±9.7 years old (Begait goat and sheep), 50.00±10.4 and 50.46±9.4 (Hassan goat and Rutanna sheep) and 46.58±11.3 and 48.18±11.9 (Arado goat and sheep), and respondents with family sizes of 6.54±2.1 and 6.22±1.9 (Begait goat and sheep), 6.51±2.3 and 9.51±5.9 (Hassan goat and Rutanna sheep) and 6.64±2.1 and 6.30±1.8 (Arado goat and sheep), respectively were involved in the survey. Mean arable landholding cultivated under rain-fed condition of the respondents were 2.33±1.4 and 14.87±42.2 hectares (ha) (Begait goat and sheep), 27.37±70.7 and 209.1±244.5 ha (Hassan goat and Rutanna sheep) and 1.24±1.8 and 1.02±1.0 ha (Arado goat and sheep), respectively. Cattle and goats were dominantly reared in Begait goat (10.19±9.1 and 4.30±2.8 TLU) and Arado goats (4.77±3.2 and 1.27±0.9 TLU) respondents whilst sheep (8.51±9.0 TLU in Begait sheep and 22.31±17.1 TLU in Rutanna sheep respondents) and cattle (4.08±2.4 in Arado respondents) were the dominantly reared livestock (Table 2).

The indigenous goat and sheep populations were kept

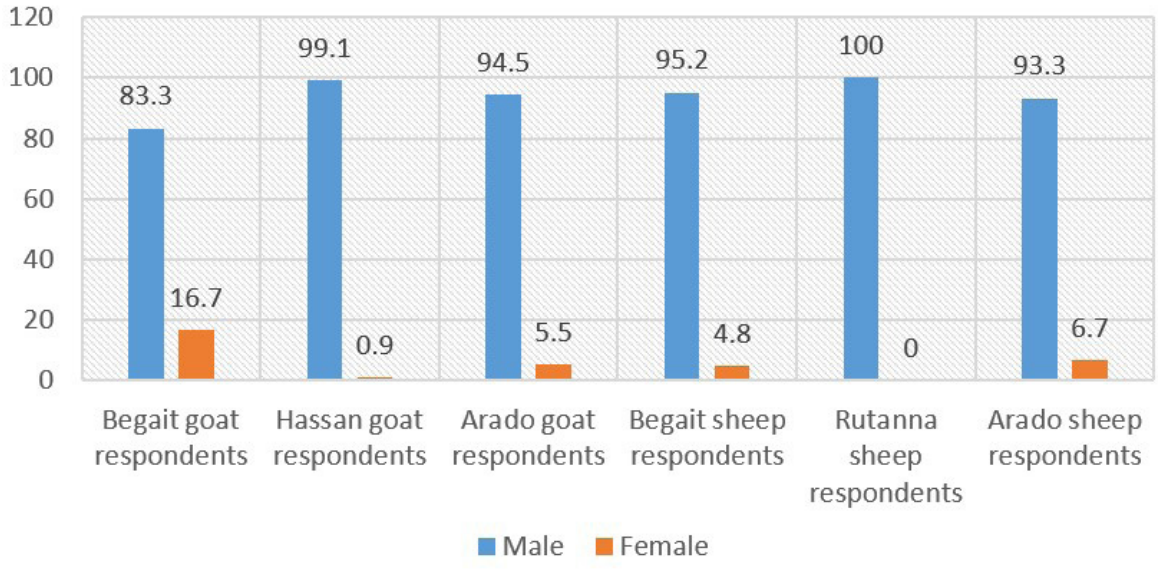

Figure 1: Gender of indigenous goat and sheep respondents (%)

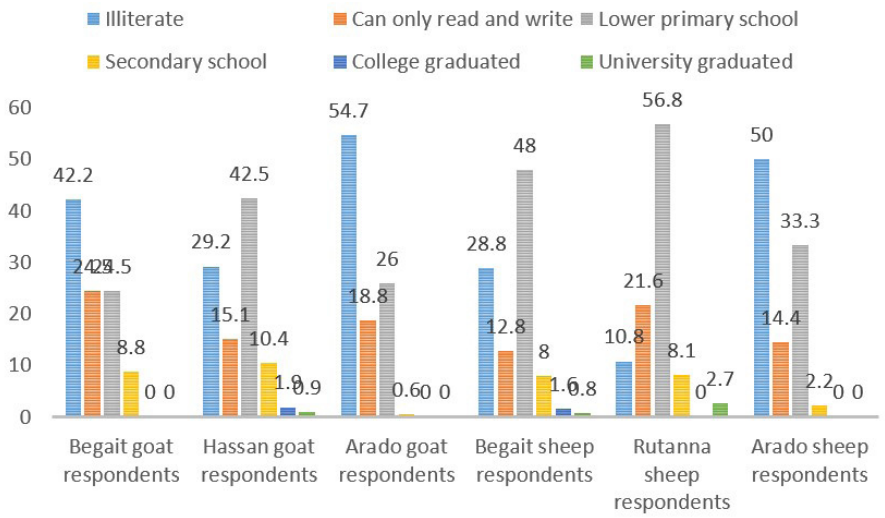

Figure 2: Educational backgrounds of indigenous goat and sheep respondents (%)

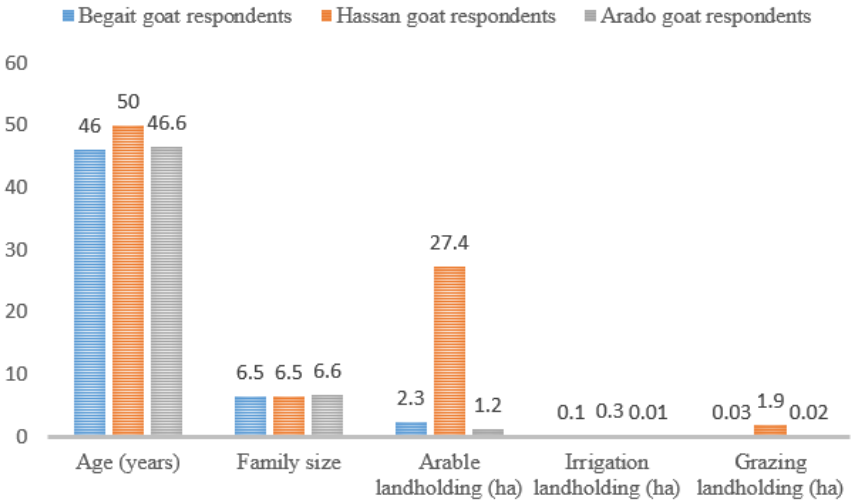

Figure 3: Mean age, family size and landholding of indigenous goat respondents

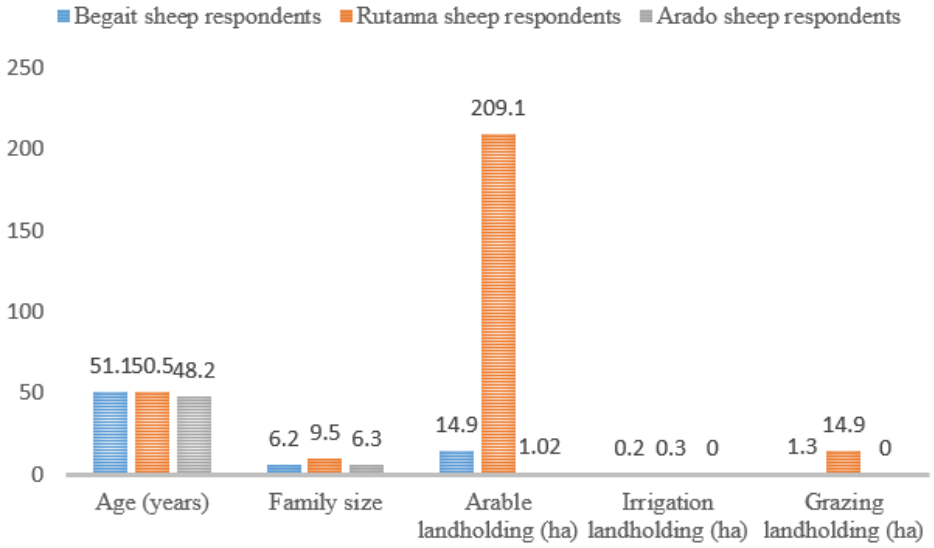

Figure 4: Mean age, family size and landholding of indigenous sheep respondents

Table 2: Household livestock and honeybee (Mean±SD) holding of the indigenous goat and sheep respondents

Goat survey				
Livestock and honey bee holding	**Begait goat respondents**	**Hassan goat respondents**	**Arado goat respondents**	**P value**
Cattle holding (TLU)	10.19±9.1	8.34±14.9	4.77±3.2	0.000
Sheep holding (TLU)	0.75±1.1	8.52±9.1	0.16±0.4	0.000
Goats holding (TLU)	4.30±2.8	7.03±5.3	1.27±0.9	0.000
Chickens holding (TLU)	0.07±0.1	0.09±0.1	0.04±0.1	0.000
Donkeys holding (TLU)	0.73±0.9	0.61±0.8	0.51±0.4	0.052
Camels holding (TLU)	0.31±0.5	0.01±0.1	0.02±0.1	0.000
Honeybees holding (number)	0.08±0.3	0	0.78±1.5	0.000
Mules holding (TLU)	0	0	0.1±0.1	0.177
Horse holding (TLU)	0	0	0.11±0.4	0.001
Sheep survey				
Livestock and honey bee holding	**Begait sheep respondents**	**Rutanna sheep respondents**	**Arado sheep respondents**	
Cattle holding (TLU)	6.62±12.6	21.53±41.7	4.08±2.4	0.000
Sheep holding (TLU)	8.51±9.0	22.31±17.1	1.17±0.8	0.000
Goats holding (TLU)	4.15±4.4	8.79±7.8	0.19±0.4	0.000
Chickens holding (TLU)	0.10±0.2	0.21±0.5	0.04±0.1	0.001
Donkeys holding (TLU)	0.49±0.6	0.14±0.3	0.88±0.6	0.000
Camels holding (TLU)	0.01±0.1	0	0	0.606
Honeybees hives (number)	0	0	0.86±1.4	0.000
Mules holding (TLU)	0	0	0.03±0.1	0.025
Horse holding (TLU)	0	0	0.44±0.8	0.000

SD=Standard Deviation, TLU=Tropical Livestock Unit

under low input extensive production system (Figures 4-9). The current production system is in line with EIAR (2022) report on Boer and Central highland crossbred goat production systems.

Livestock Economic Importance And Income Sources

Economic importance of livestock of the study areas was ranked in both goat and sheep surveys. According to the goat survey, goat, cattle and sheep were ranked

Table 3: Ranking Indices of Economic Importance of Livestock Species

Livestock-Goat survey	**R1**	**R2**	**R3**	**Index**
Cattle	69	135	92	0.264
Sheep	69	62	34	0.170
Goats	220	127	12	0.430
Chickens	3	19	81	0.059
Donkeys	4	8	89	0.054
Camels	1	2	10	0.008
Honeybee	3	5	12	0.014
Livestock-Sheep survey				
Cattle	33	64	82	0.201
Sheep	179	56	12	0.431
Goats	40	95	24	0.218
Chickens	3	16	51	0.060
Donkeys	7	17	59	0.074
Honeybees	6	1	4	0.016

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 livestock 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 livestock rankings.

Table 4: Ranking indices of income sources in goat and sheep respondents

Income source-Goat survey	R1	R2	R3	Index
Crop Production	274	32	35	0.413
Cattle Production	10	72	150	0.145
Goat Production	48	201	100	0.290
Sheep Production	37	47	37	0.109
Chicken Production	2	2	16	0.012
Other Livestock	0	3	15	0.009
Off Farm	2	4	4	0.008
Irrigation	4	8	2	0.013
Income source-Sheep survey				
Crop Production	175	18	39	0.390
Cattle Production	7	33	67	0.100
Goat Production	18	61	57	0.151
Sheep Production	52	126	48	0.296
Chicken Production	0	3	14	0.013
Other Livestock	2	1	11	0.012
Off Farm	3	2	7	0.013
Irrigation	4	11	4	0.025

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 income source 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 income sources.

first, second and third whilst sheep, goats and cattle were ranked first, second and third in sheep survey, respectively (Table 3). Indigenous goat respondents reported that the first, second and third ranked income sources of the respondents were crop, goat and cattle whereas crop, sheep and goat were the first, second and third ranked income sources of the sheep respondents (Table 4).

The economic importance of the major livestock species in the sheep survey of first economically important species (sheep-1) is in line with Amare *et al.* (2019) report on Begait Sheep in Ethiopia (sheep-1).

Flock Dynamics of Indigenous Goat and Sheep Populations in 2017 Production Year

The flock dynamics (%) of indigenous goat (Figures 4-6) and sheep (Figures 7-9) in 2017 production year were calculated. The major entry in all the indigenous goat and sheep was additions of newborns to the flocks. Sale and death were the first and second ranked exits in indigenous goats and sheep (Table 5). Except Hassan goats (+0.1%), flock dynamics in entries and exits of indigenous goat and sheep was at decreasing rates. Begait flock (-16.5%) and Arado flock (-16.7%) goat populations

Table 5: Percent flock dynamics of indigenous goat and sheep populations in 2017 production year

Entry and exit description	Goat breeds			Sheep breeds		
	Begait	Hassan	Arado	Begait	Rutanna	Arado
Goat entry due to				-	-	-
Kids born	42.3	40.7	53.3	-	-	-
Goats bought	0.5	1.7	3.0	-	-	-
Goats donated	0.0	0.0	0.0	-	-	-
Goats exchanged	0.0	0.0	0.3	-	-	-
%Entry	42.8	42.4	56.7			
Goat exit due to				-	-	-
Death	23.6	17.2	19.0	-	-	-
Sold for Breeding	16.1	16.0	24.9	-	-	-
Sold for Slaughter	8.3	6.0	14.5	-	-	-
Stolen	4.3	1.2	2.8	-	-	-
Predator Attacked	7.1	2.1	12.2	-	-	-
%Exit	59.4	42.3	73.4			

Sheep entry due to						
Lambs born	-	-	-	32.5	38.0	46.0
Sheep bought	-	-	-	0.9	0.8	1.8
%Entry	-	-	-	33.3	38.8	47.8
Sheep exit due to	**-**	**-**	**-**			
Death	-	-	-	13.1	20.8	10.0
Sold for Breeding	-	-	-	14.3	14.0	24.8
Sold for Slaughter	-	-	-	5.0	5.2	14.8
Stolen	-	-	-	0.9	0.5	0.0
Predator Attacked	-	-	-	2.7	0.9	1.3
%Exit	-	-	-	36.0	41.4	50.9

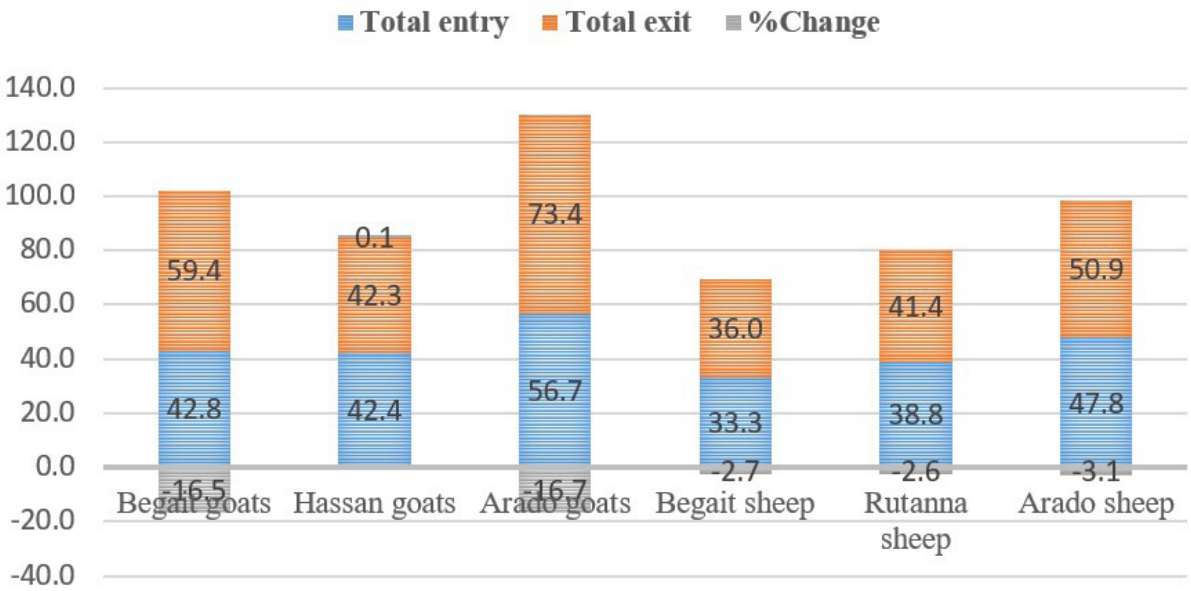

Figure 5: Flock dynamics of indigenous goats and sheep in 2017 production year (%)

Figure 6: Begait goats (Adi-Asser, Tahtay Adiabo district)

Figure 7: Hassan goats (May Kadra, Kafta Humera district)

Figure 10: Rutanna sheep (May Kadra, Kafta Humera district)

Figure 8: Arado or Tigray Highland goats (Highland Welkait district)

Figure 11: Arado or Common Tigray Highland sheep (Cheguar Kuddo, Tsegede district)

Figure 9: Begait sheep (Adebay, Kafta Humera district)

were highly decreased compared to indigenous sheep flock populations (Figure 5).

Production Challenges and Opportunities in Indigenous Goat and Sheep

About 92% of Begait, 99% of Hassan and 99% of Arado goat respondents reported that there were production challenges in indigenous goat production whilst 87% of Begait, 80% of Hassan and 38% of Arado goat respondents reported that there were production opportunities in indigenous goat production of the study areas. Indigenous sheep production challenges were reported by all respondents (100%) whilst opportunities were reported by 76% of Begait, 100% of Rutanna and 53% of Arado sheep respondents (Table 6). The first, second and third ranked production challenges in the indigenous goat and sheep were rangeland scarcity, diseases and lack of veterinary services, respectively (Table 7).

The current challenges in indigenous goats are in line with Banerjee *et al.* (2000) report on challenges of goat production in East Africa (overstocking-1, diseases-2 and shortage of infrastructure-3), and EIAR (2020) report on goat production and breeding characterization in Mandura, Metekel Zone, Ethiopia (shortage of feed-1 and diseases-2). Rangeland scarcity (first), diseases (second) and lack of veterinary services (third) are not in agreement with Shegaw *et al.* (2021) report on indigenous goats in South Western Ethiopia (disease-1, predator-2 and feed shortage-3), Abdi *et al.* (2023) report on goat husbandry practices in Dollo Zone, Somali Regional State Ethiopia (drought-1, feed shortage-2 and water shortage-3), Hailu (2023) report on indigenous goats in North Shewa Zone, Amhara Region, Ethiopia (Feed shortage-1, disease-2 and labor shortage-3), Alefe (2016) report on indigenous goat types and their production system in Shabelle Zone, South Eastern Ethiopia (drought-1, disease-2 and feed and water shortage-3), EIAR (2020) report on constraints of goat production in Northwestern lowlands of Ethiopia (diseases and parasites-1, inadequate veterinary

services-2 and predators-3), Alubel (2015) report on major constraints of goat production in Ziquala and Tanqua Abergelle districts (drought-1, disease-2 and feed shortage-3), ESAP (2015) report on husbandry practices of North Western Highland goat in West Gojjam Zone of Amhara Region, Ethiopia (disease-1, predators and theft-2, labor scarcity-3), Gatew *et al.* (2017) production constraints report on Borana goats (diseases-1, feed shortage-2 and drought-3) and on Short-eared Somali goats (drought-1, disease-2 and feed shortage-3), Gatew *et al.* (2017) production constraints report on Borana goats (diseases-1, feed shortage-2 and drought-3) and on Short-eared Somali goats (drought-1, disease-2 and feed shortage-3), and Tade *et al.* (2023) report on husbandry practices of indigenous goat populations in South Gondar Zone, Ethiopia (disease occurrence-1, feed shortage-2 and drought occurrence-3). The differences could be due to agro-climatic environment, farming system, infrastructures, genotype, community livelihood status, occurrences of drought, production system and extension support systems.

The current first and second ranked sheep production challenges are in line with the report of Gizaw *et al.* (2013a) at pastoral and subalpine sheep-barley production systems (feed shortage-1 and diseases-2). The current challenges in indigenous sheep are not similar with Amare *et al.* (2019) report on ranking of Begait Sheep challenges in Kafta Humera District in Ethiopia (diseases-1, water shortage-2 and feed shortage-3), Getaneh and Mekete (2023) report on livestock production constraints and husbandry practices in South Omo Zone, Ethiopia (livestock diseases and parasites-1, absence of improved livestock breeds-2 and limited availability of improved forages-3), Azimi *et al.* (2022) report on sheep production systems and breeding practices in Badghis Province, Afghanistan (feed shortage-1, lack of capital-2, insufficient veterinary services and limited grazing land-3), Helen *et al.* (2015) report on indigenous sheep production system in Eastern Ethiopia (feed shortage-1, water scarcity and drought-2 and disease prevalence-3), Gedefaw and Gebremariam (2019) report on small holder sheep production in Habru Woreda North Wollo Zone of Amhara, Ethiopia (feed shortage-1, shortage of grazing land-2 and endemic disease-3), Fekerte (2008) report on Blackhead Somali sheep breed in Shinile and Erer Districts of Shinile Zone, Ethiopia (disease incidence-1, shortage of feed-2 and shortage of water-3), Lelisa and Taye (2020) report on husbandry practices and major constraints of sheep and goat production in Sinana district, Bale Zone, Ethiopia (feed shortage-1, lack of grazing area-2 and lack of land for production-3), Singh *et al.* (2018) report on goat (facility of grazing-1, lack of awareness-2 and high cost of medicine-3) and sheep (facility of grazing-1, high cost of medicine -2 and lack of awareness-3) husbandry practices in Allahabad district of Uttar Pradesh, India, Admasu *et al.* (2017) report on traditional sheep production systems and breeding practice in Wolayita Zone of Southern Ethiopia (feed and grazing land shortages-1, disease-2 and drought-3). The differences might also be due to agro-climatic environment, farming system, genotype, infrastructure, community livelihood status, occurrences of drought, production system and extension support systems.

Moreover, the current production opportunities of goat and sheep are not in agreement with Lelisa and Taye (2020) report on husbandry practices and major opportunities of sheep and goat production in Sinana district, Bale Zone, Ethiopia (favorable agro-ecology-1, presence of good breed-2 and market access-3), however, the second ranked opportunity by Lelisa and Taye (2020) is in line with the current second ranked production opportunity of the indigenous sheep. The differences could be due to agro-climatic environment, farming system, extension support system, occurrences of drought-diseases-parasites, community awareness and socioeconomic circumstances of the study areas.

Table 6: Frequency (%) of challenges and opportunities in indigenous goat and sheep

Goat challenges	**Begait goat**	**Hassan**	**Arado goat**
Yes	94(92.2)	105(99.1)	180(99.4)
No	8(7.8)	1(0.9)	1(0.6)
Goat opportunities			
Yes	89(87.3)	85(80.2)	68(37.6)
No	13(12.7)	21(19.8)	113(62.4)
Sheep challenges	**Begait**	**Rutanna**	**Arado**
Yes	126(100.0)	37(100.0)	90(100.0)
No	0	0	0
Sheep opportunities			
Yes	96(76.2)	37(100.0)	48(53.3)
No	30(23.8)	0	42(46.7)

Table 7: Ranking indices of production challenges and opportunities of indigenous goat and sheep

Challenges in goat production	**R1**	**R2**	**R3**	**Index**
Diseases	86	59	15	0.210
Predator	29	43	25	0.106
Drought	4	3	8	0.014
Theft	9	18	18	0.043
Feed Scarcity	2	12	8	0.020
Rangeland Scarcity	216	53	40	0.426
Water Scarcity	5	19	13	0.035
Labor Scarcity	3	10	4	0.018
Lack of Vet Service	28	55	14	0.112
Deforestation	0	11	7	0.016
Opportunities in goat production				
Rangeland Access	37	4	0	0.141
Access to Diverse Forage	38	21	1	0.186
Market Demand	122	16	1	0.472
Superior Breed	37	12	2	0.162
Access to Vet Service	7	6	1	0.040
Challenges in sheep production				
Rangeland Scarcity	157	51	36	0.492
Diseases	52	53	11	0.221
Predators	3	6	1	0.018
Theft	2	6	4	0.018
Water Scarcity	11	22	19	0.078
Deforestation	0	5	5	0.012
Marketing Linkage Problem	0	5	7	0.014
Poor Vet Service	29	43	11	0.149
Opportunities in sheep production				
Market Demand	76	60	0	0.480
Good Breed	100	22	1	0.476
Access to Crop Residue	6	5	4	0.044

Index = sum of (3 × number of households who ranked first + 2 × number of households who ranked second + 1 × number of households who ranked third) given for each challenge/opportunity divided by sum of (3 × number of households who ranked first + 2 × number of households who ranked second + 1 × number of households who ranked third) for all challenges/opportunities.

Major Diseases and External Parasites of Indigenous Goats and Sheep

The major diseases and external parasites of the indigenous goat and sheep of the study areas were ranked. The first, second and third ranked diseases in both goat and sheep were shipping fever or pasteurellosis, Coenuruses and Contagious Caprine Pleuropneumonia (CCPP), respectively. The first and second ranked external parasites in both goat and sheep were ticks and fleas whilst the third ranked external parasites in goats was sore mouth and in sheep was jigger flea infestation (Table 8).

The current first and third ranked goat diseases are similar with the report of Tsegaye (2009) in goats of Metema, Northern Ethiopia (pasteurellosis-1 and CCPP-2). The current major diseases of the indigenous goats are not similar with Shegaw *et al.* (2021) report on indigenous goats in South Western Ethiopia, Abdi *et al.* (2023) report on goat husbandry practices in Dollo Zone, Somali Regional State Ethiopia (tick lameness-1, CCPP-2 and PPR-3), EIAR (2020) report on constraints of goat production in Northwestern lowlands of Ethiopia (PPR-1, CCPP-2 and Trypanosomiasis-3), and Alubel (2015) report on major goat diseases in Tanqua Abergelle district (PPR-1, sheep and goat pox-2 and shipping fever-3). The differences could be due to ecological, access to veterinary services, production system, level of management and genotype.

The current major diseases of the indigenous sheep are not similar with Amare *et al.* (2019) report on Begait Sheep in Ethiopia (mange-1, shipping fever-2 and Sheep pox-3), Azimi *et al.* (2022) report on sheep production systems and breeding practices in Badghis Province, Afghanistan (foot rot-1, foot and mouth disease-2 and Coenuruses-3),

Singh *et al.* (2018) in goat (bloat-1, respiratory disease-2 and diarrhoea-3) and sheep (diarrhea-1, respiratory disease-2 and bloat-3) husbandry practices in Allahabad district of Uttar Pradesh, India, and Lamesegn *et al.* (2018) report on husbandry practices of sheep in Hulet Eju Enesie District, East Gojjam Zone, Ethiopia (pasteurolosis-1,

Table 8: Ranking indices of diseases and external parasites of indigenous goat and sheep

Diseases in Goat Production	**R1**	**R2**	**R3**	**Index**
Shipping Fever (Ovine Pasteurellosis)	145	49	18	0.362
Coenuruses	103	30	17	0.254
Contagious Caprine Pleuropneumonia (CCPP)	48	61	17	0.186
Goat arthritis	1	7	10	0.018
Goat Pox (Capripox)	16	58	31	0.128
Tunga Penetrans	9	16	11	0.046
Goat Plague (PPR)	1	1	4	0.006
External Parasites in Goats				
Ticks	180	62	12	0.425
Fleas	130	109	44	0.410
Goat lice	14	16	13	0.055
Botfly (Oestrus ovis)	4	10	21	0.033
Jigger flea infestation	2	7	5	0.016
Mosquito (Rift Valley Fever)	0	3	0	0.004
Sore Mouth (Contagious Ecthyma)	12	25	7	0.058
Diseases in Sheep Production				
Shipping Fever (Ovine Pasteurellosis)	87	50	25	0.377
Sheep pox	13	29	24	0.118
Goat plague (PPR)	1	0	4	0.007
Coenuruses	81	23	8	0.290
Sheep pneumonia (CCPP)	36	44	17	0.208
External Parasites of Sheep				
Fleas	41	66	16	0.262
Sheep lice	1	12	10	0.036
Ticks	132	28	6	0.442
Jigger flea infestation	34	32	20	0.180
Botfly (Oestrus ovis)	5	17	35	0.081

CCPP- Contagious Caprine Pleuropneumonia

sheep pox-2 and anthrax-3). The differences might be due to ecological aspects, production system, access to veterinary services, level of management and genotype. The first ranked external parasite of the indigenous goat and sheep is in line with Azimi *et al.* (2022) report on sheep production systems and breeding practices in Badghis Province, Afghanistan (ticks-1).

CONCLUSION

The indigenous goat (Begait, Hassan and Arado) and sheep (Begait, Rutanna and Arado) populations were kept under low input extensive production system. Goat, cattle and sheep were ranked first, second and third in goat survey whilst sheep, goats and cattle were ranked first, second and third in sheep survey, respectively based on the economic contributions of livestock to the respondents. Indigenous goat respondents reported that the first, second, and third ranked income sources of the respondents were crop production, goat production and cattle production, whereas crop production, sheep production and goat production were the first, second, and third ranked income sources of the indigenous sheep respondents.

The major entry in all the indigenous goat and sheep in 2017 production year was addition of newborns to the flocks. Sale and death were the first and second ranked exits in indigenous goats and sheep. Except Hassan goats (+0.1%), flock dynamics (%) in entries and exits of indigenous goat and sheep flocks were at decreasing rates due to different challenges. Begait flock (-16.5%) and Arado flock (-16.7%) goat populations were highly decreased in 2017 production year compared to indigenous sheep flock populations.

Respondents of indigenous goat (92% of Begait,

99% of Hassan and 99% of Arado) and sheep (all respondents-100%) reported production challenges, and negatively affected productivity. Respondents of indigenous goat (87% of Begait, 80% of Hassan and 38% of Arado) and sheep (76% of Begait, 100% of Rutanna and 53% of Arado respondents) reported production opportunities which could enhance small ruminant productivity. The first, second and third ranked production challenges in the indigenous goat and sheep were rangeland scarcity, diseases and lack of veterinary services, respectively. Rangeland scarcity directly negatively affected annual reproductive rate of the indigenous goat and sheep of the study areas. The first, second and third ranked diseases in both goat and sheep were shipping fever, Coenuruses and CCPP, respectively. The first and second ranked external parasites in both goat and sheep were ticks and fleas whilst the third ranked external parasites in goats was sore mouth and in sheep was jigger flea infestation.

Therefore, the diseases, external parasites and challenges should be taken in to account in the designing of genetic improvement strategies of the indigenous goat and sheep genetic resources of the study areas. Veterinary service centers should also be accessible to all indigenous goat and sheep producers in the study areas.

Acknowledgement

The authors would like to thank to Tigray Agricultural Research Institute for its financial and transport supports, and we also greatly thank Leul Berhe Shishaye who contributed in diseases and external parasites identification and nomenclatures.

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