



Phenotypic Characterization and Assessment of Farmer's Husbandry Practices of Hararghe Cattle Breed, in the Hararghe Highland of Ethiopia

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ABSTRACT

The study was carried out in three districts of East Hararghe zone, Oromia Regional State, Ethiopia, from August 2022 through April 2023, with the objectives of phenotypic and production system characterizing and to assess breeding and husbandry practices of the communities in the study areas (Fadis, Gursum and Goro districts). Field observations, semi-structured questionnaires, focus groups, interviews with key informants, linear body measurements of sample indigenous cattle, and secondary data gathering from various sources were used to acquire the data. Using non-parametric methods interviews were conducted with a total of 168 households (56 from each district), and 345 matured cattle were sampled for morphological description and linear body measurements. The average number of cattle per family was 5.91 ± 0.35 , and there were highly significant differences ($p < 0.0001$) between districts. Female Harar cattle on average had 71.5% white-gray, 8.9% white, 14.6% red and 1.2% white and red coat colors, whereas, white-gray 72.7%, type followed by red (12.1%), white (9.1%), and white and red 1.7% male. In coat color pattern, the plain was 85.8% and 90.2% male and female and the remaining patterned were 4.2% and 2.2% shade; 7.0% and 3.0% spotted female and male respectively. Female cattle linear body measurement on major linear body measure variables was Body length (115.7 ± 0.93), Heart girth (150.5 ± 0.76), Height at rump (116.6 ± 0.82), Height at withers (107 ± 0.51), whereas in male cattle population a linear measurement of 120.8 ± 1.4 , 153.5 ± 1.2 , 118.7 ± 1.31 , 109 ± 0.81 cm respectively. These measures had a moderate correlation, $r=0.64$, 0.67 , 0.60 on female cattle, whereas, $r=0.68$, 0.67 and 0.66 respectively and matured female and male cattle were weighed 265.27Kg and 268.24Kg respectively.

1. INTRODUCTION

Beginning with animal domestication, livestock populations have been constantly disrupted by selective breeding or intervention in response to the needs of the owners, as well as natural selection to adapt to the local production environment (Berhane, 2017). Southwest Asia was thought to be the origin of the majority of these domestic animals. Previous research has looked into the origins and evolution of African livestock, and some of the findings have revealed the majority of African cattle breeds in the Horn of Africa are descended and domesticated through long horn hump-less cattle, zebu and crossbreeding between cattle (*B. Taurus* and *B. Indicus*) imported from Asia around 700 A.D (Grigson, 1991; Stock and Fifford-Gonzalez, 2013, Decker *et al.*, 2014; Okeyo *et al.*, 2015; Kim *et al.*, 2017). This interbreeding took place primarily between 1000-200BC in Ethiopia and is divided into five major cattle types (Epstein, 1971): large and small East African Zebu, Sanga, Zenga (a cross between Sanga and Zenga), and Touraine types, which can be found in all agro-ecological zones, ranging from arid tropical to afro-alpine ecosystems, depending on their suitability for a particular production system (Rege, 1999). This domestication of cattle was started as a means of obtaining usable products or services, as well as for socio-cultural reasons. Although knowledge-based selective breeding may have existed since the dawn of time, the Romans (around 2000 bp) were the first to use it (Buffum, 1909). However, the commercial cattle industry is confronted with several new issues. In recent decades, there has been a rapid shift in livestock breeds used in developing countries due to global drivers, such as increasing demand for livestock products and market-oriented production (Zewdu, 2010). On the other hand, local breeds have been replaced by exotic breeds, leading to a loss of genetic resources Rege *et al.* (2011) as a result of human intervention. Changes in economic, social, and environmental factors affecting the population of local livestock breeds might offer opportunities but also pose threats to the livelihoods of poor farmers (Rege *et al.*, 2011).

Ethiopia, with 70 million cattle, 40 million sheep, 51 million goats, 8 million camels, and 49 million chickens in 2021, makes it to have the largest livestock population in Africa (CSA, 2021). Between 2000 and 2016, the average livestock stock per 100 inhabitants, measured in tropical livestock units (TLU), was 51 TLU, more than double the continental median of 23 TLU. During the same period, the average gross production value growth rate was 4.5 percent, which was also higher than the continental median of 2.2 percent (FAO, 2019). The national herd supports, at least in part, the livelihoods of more than 11.3 million rural households, including 27– 35 percent of the highland livestock keepers, and a large proportion of the lowland herders, who live below the established poverty line (Shapiro *et al.*, 2017).

Livestock is an important source of animal protein, crop cultivation power, transportation, export

commodities, manure for agriculture and household energy, crop failure security, and wealth creation. In 2017, the industry provided up to 40 percent of agricultural GDP, over 20 percent of total GDP, and 20 percent of national foreign currency earnings (World Bank, 2017). Even though encouraging work has been done to document the extent of diversity in many of these species for the past two decades, evidence from earlier studies of cattle diversity in the area (Rey *et al.*, 1997) indicated that some indigenous breeds are endangered in Ethiopia. As a result, numerous research studies have been undertaken to date and 32 indigenous cattle breeds have been recognized (DAGRIS, 2019). There is, however, a livestock population in some remote areas that has yet to be recognized. Increasing transhumance and migration in lower altitude places has resulted in extensive interbreeding between previously isolated animal populations according to Workneh *et al.* (2003).

Thus, the breed may be production-stress tolerant. Many sorts of research has been done on phenotypic and genetic characterization of the cattle to identify, characterize, and conserve the diversity of various classes of cattle in Ethiopia; However, little work has been done to characterize the Hararghe cattle population/ subtype. There is also inadequate breed-level characterization information (Rowlands, 2018). Therefore, the characterization of the cattle population is necessary for the proper identification of breeds and to suggest an appropriate breeding program for sustainable improvement, conservation, and sustainable utilization of animal genetic resources (FAO, 2015). Hence, based on these backgrounds, the current study was undertaken with the objective of phenotypically characterizing Hararghe Highland cattle and assessing breeding and husbandry practices of the communities in selected districts of East Hararghe zone, Oromia region, Ethiopia.

2. MATERIALS AND METHODS

3.1. Sampling Techniques and Data Collection

A reconnaissance was made in advance together with the local staff of Livestock Development to get familiarized with the range of agroecological conditions and the existing farming systems in the study area. Meetings were held with local farmers and all opportunities were taken for wayside informal talks, key informant contact, and focal group discussions. Before choosing the survey districts, zonal experts from the rural and agricultural development office and farmer representatives had discussions regarding the area's native cattle as well as the region's existing production practices and locations where the pure Harar cow breed predominates. A multistage sampling technique was employed through purposive and random sampling of farmers. After discussion, three districts were chosen based on the potential production (population), distribution, and movements of this livestock [one from each lowland (Gursum), midland (Fadis), and highland (Goro gutu)]. In light of this, two

kebeles (PA) from each district were randomly chosen. In Ethiopia, a peasant association is the smallest unit of an administrative structure below a district; it often has 500–1500 households (Mulu *et al.*, 2022). Finally, 168 households were selected from the three districts using simple random and systematic random sampling procedures, respectively. The number of respondents was taken based on probability proportional to the population size of each kebele. The list of households from each kebele to get the sampling frame and the sample size was determined following (Cochran, 1977; Kothari *et al.*, 2004, Thrusfield, 2007).

$$n = \frac{Z^2 * p * q * N}{e^2 (N - 1) + Z^2 * p * q}$$

where N is the total households; Z, confidence level 95% (1.96); P, sample proportion, 50 percent (0.5); q = 1 – p and e, the desired level of precision 5 percent (0.05).

To study livestock breeds, a modified version of an ILRI (International Livestock Research Institute, 2012) questionnaire was followed. It is used to gather data on the general socioeconomic features of households, the herd structure, breeding management, feed and feeding management, the prevalence of diseases, and production limits. Before execution, the questionnaires were pre-tested, and certain adjustments, reframing, and corrections were made in following the respondent's perception. A group of enumerators who had been specially hired and trained for the job and were under the researcher's direct supervision the questionnaire was administered to the randomly chosen household heads or representatives. Local agricultural development agents, local leaders, and cattle owners were also interviewed informally to incorporate local knowledge about cattle breeds to validate the information collected from the formal interview.

To gather information on cattle husbandry practices and desirable and undesirable characteristics of Hararghe cattle, a semi-structured questionnaire was also given to farmers who owned Hararghe cattle in six kebeles that were identified through focus group discussions. Questionnaire interviews were developed to learn about the feeding and watering system, breeding system, housing, culling and other major husbandry practices including health systems, major purpose of cattle keeping (objectives), and constraints of cattle production in general. To support the data gathered through individual farmer interviews, focus groups were convened with older farmers, village leaders, and socially respected farmers who were thought to have a greater understanding of the current and previous social and economic situation of the study areas. Information on the current state and main restraints facing the breed, indigenous knowledge on the management of breeding, major constraints, and alternative approaches to solving these issues were gathered through group discussions. Additionally, secondary information on the number of people and animals, agroecology, patterns of land use,

topography, and climate was acquired from district and zonal agriculture and rural development offices. The study was conducted August 2022 through April 2023.

3.1.1. Linear Body Measures and Morphological Traits

Body measurements and physical characteristics were recorded qualitatively and quantitatively using a format adapted from the FAO standard description list (2012). When choosing morphological criteria, the standard breed descriptor list for cattle created by FAO (2012) was rigorously observed. Using measuring tape, the following quantitative characteristics were determined: body length, height at the withers, heart (chest) girth, height at the rump, forehead width, rump length, horn length, ear length, tail length, pelvis width, neck length, and muzzle circumference. The animals' dentitions and information from cattle owners were used to estimate their ages. For the linear measurements, animals with above two permanent pairs of incisors or more than two years of age were chosen. In this regard, ninety-nine (99) mature males and 246 breeding females in the sample families holding cattle from the three districts; qualitative and quantitative features were noted. These procedures were done by following FAO (2012) guidelines, which recommend a sample size of approximately 10–30 males and 100–300 females, the sample size was set. Approximately on average (0.59 to 1) bull and (1.46) female cattle were used for the current study from each sample of 56 households of each district. During physical measurements, was before feeding, only mature animals that were not related and pregnant animals were excluded.

3.2. Method of Data Analysis

3.2.1. Descriptive Statistics

The Statistical Package for the Social Sciences (SPSS) was used to examine the qualitative phenotypic data and survey results (SPSS for Windows, release 25.0, 2018). Descriptive statistics and association of categorical variables were carried out. Chi-square analysis was used to compare the mean for non-parametric survey data and their significance was tested using the Pearson method.

3.2.2. Univariate Analysis

A general linear model procedure (PROC GLM) of the Statistical Analysis System (SAS 9.4, version 2016) was employed for quantitative variables to detect statistical differences among sampled cattle populations. Separation of means was determined by a one-way analysis of variance followed by Tukey's honestly significant difference. Statistical significance was separated (assessed) at ($p < .05$). The effects of sex, districts and sex interaction with district or ecology on linear body size measures were evaluated using the following linear model.

$$Y_{ijk} = \mu + S_i + D_j + (S * D)_{ij} + e_{ijk}$$

Where; Y_{ijkl} = the observed l^{th} (linear body measurements) in the i^{th} sex and j^{th} district and the interaction of ij^{th} combined (interaction) sex and districts effects; μ = overall mean;
 S_i = effect of the i^{th} sex (Male, Female)
 D_j = the effect of the j^{th} district on linear body measurement (3 districts)
 e_{ijk} = random residual error associated with the record of each animal

A sampled households' index of responses was calculated as the following method used by Musa *et al.* (2006) and Tilahun *et al.* (2016)

$$\text{Ranking index} = \frac{(R_n * C_1 + R_{n-1} * C_2 \dots + R_1 * C_n)_{1-n}}{\sum_{1-n} (R_n * C_1 + R_{n-1} * C_2 \dots + R_1 * C_n)}$$

Whereas,

R_n = Value of the least rank of constraint a (if the least rank is 7th, then $R_n = 7$, $R_{n-1} = 6$, $R_1 = 1$)

C_n = Counted value of the least ranked level (in the above example, the counts of the 7th rank = C_n , and C_1 = the count of the 1st rank)

$(R * C + R * C \dots + R * C) = *W$ = weighted summation of each constraint (a, b, c,...). The index formula was employed to calculate a ranking index for the disease and their services, selection criteria for breeding purposes, and major production constraints.

The normality test was done by reclassifying statistics for the sample populations of female and male, districts, and ages, to remove the outliers (Table 10) from the raw data. The measured data was tested for normality and homogeneity using the Shapiro Wilk test and there was no violation of normality for all data from all districts across animal types.

- Effective population sizes (N_e) per research site and combined population were estimated following (Falconer and Mackay, 1996);

Caballero (1994), Hedrick (2000), and Frankham, Ballou, and Briscoe (2004)

$$N_e = \frac{4 * N_f * N_m}{N_f + N_m}$$

$$\Delta F = \frac{1}{2 N_e} \text{ (Falconer and Mackay, 1996)}$$

4. RESULTS AND DISCUSSION

4.1. Livestock Holding and Species Compositions

The average number of livestock species per household in the study area is indicated in Table 2. In the current finding, it was revealed that there was a significant difference among the smallholder farmers in the average number of livestock species held in all the study areas at ($p < 0.05$). Accordingly, cattle were the most important livestock species, followed by goats, sheep, donkeys, and chickens. Goro Gutu district had the fewest livestock as crop mixing livestock (commonly sorghum, maize, groundnut, and k'hat) for their subsistence was more practiced than the rest of the study areas. On the other hand, in the Fadis district (6.86 ± 0.42) a higher number of livestock was observed in smallholder's households and showed lower at Goro gutu (5.55 ± 0.33) as the farmers in the area have integrated livestock with crop production whereas, crop integration was less in comparisons and farmers more of used feedlot to fattening their cattle. Besides, personal observation and key informant interviews notified that households in Fadis district are more dependent on aid and foreign NGOs participate in improving the food security and livelihood of smallholders in the area (Shumetie and Mamo, 2019). This average number of herds in the study areas shows far less than the reports which was from Chali (2014), 11.33 cattle holding per household in the Arsi highlands, 7.8 Haptamu in the Benishangul gumuz, 11.12 Andualem (2015), in the Essera district, Dawuro Zone of Ethiopia.

Table 2. Average number of Livestock holbdings per households in the study districts

Livestock species	Fadis N= 56	Gursum (N=56)	Goro gutu (N=56)	Overall (N=168)	Prob>F
Cattle	6.86±0.42	5.55±0.33	5.32±0.31	5.91±0.35	0.003
Goat	10.63±0.58	5.32±0.39	7.11±0.44	7.46±0.47	<0.0001
Sheep	4.02±0.23	4.86±0.26	4.45±0.33	3.78±0.27	0.015
Donkey	2.09±0.12	1.02±0.10	2.05±0.11	1.72±0.11	Ns
Mule	-	-	-	-	
Horse	-	-	-	-	
Camel	1.57±0.35	1.89±0.46	-	1.51±0.3	0.0004
Poultry	24.61±0.92	5.91±0.39	8.41±0.43	13±0.58	<0.0001
Beehive(traditional)	2.1±0.49	1.79±0.24	1.89±0.49	1.93±0.41	Ns

Note: N = Number of respondents; *** = significant at ($p < 0.001$); ** = significant at ($p < 0.01$); * = significant at ($p < 0.05$)

4.2. The Purpose of Cattle keeping

Almost the survey result revealed that there was no significant difference among the study districts in terms of keeping cattle either solely or in mixing agricultural systems at ($p < 0.05$), Table 3. Hararghe highland cattle breed was reported to produce tender beef compared to some other local beef cattle breeds (Gadisa *et al*, 2019) and primarily kept for cash incomes in terms of fattening which was a higher percentage (48.3%) in all study districts (Table 3) which was 30.8, 18.6 and 31.7% in Fadis, Gursum, and Goro Gutu districts. It shows less proportion in Gursum, since pastoralists are not only keeping their herds commonly for only one purpose, but for wholeness. Additionally, home consumption shared the second largest for which cattle were kept on the field in study areas (27.6% milk and 13.0% meat) in the area with a higher proportion in

Gursum than the other two districts as its semi-pastoral areas. Natural fertilizer was generated from the cattle kept that supported any crop production around the homestead of small householder farmers (31.5%) overall which was one of an implication for livestock and crop integrated. Relatively the percentage was higher in Fadis and Goro gutu as due production in these two districts was mixing production system.

Additionally, the capital asset for future uncertainty and savings (33.1% on average) was for which cattle were raised in the study woredas which is higher at Gursum and Fadis as it is specialized in pastoralism. In addition, oxen were used for traction (draught power) and threshing in the highland and midlands (Goro gutu and Fadis) in addition to being kept for fattening and were among sources of livelihood in both ecologies of current study areas.

Table 3: The main purpose for the cattle keeping in the study areas

Purpose of keeping cattle	Fadis N=56 (%)	Gursum N=56 (%)	Goro gutu N=56 (%)	Overall (N = 68) (%)	Prob>X ²
Home consumption (Milk)	12.7	22.1	10.6	27.0	0.2270
Capital asset (Saving)	18.7	22.0	14.9	33.1	
Manure	23.1	9.0	20.8	31.5	
Cash income (fattening)	30.8	18.6	31.7	48.3	
Home consumption (meat)	3.5	13.9	4.1	13.0	
Wealth status	5.1	8.0	4.0	10.2	
Social fulfilment	6.1	14.1	5.9	15.5	

N= Number of respondents

4.3. Cattle Management and Husbandry.

4.3.1. Source of Animal Feeds and watering

Healthy cattle can tolerate a wide range of temperatures if they are acclimatized and have adequate feed and water. There was no significant difference among districts in terms of cattle feeding and water sources and grazing patterns among districts. In the study areas, Tethering feed practice was 37.1 and 43.3% in Fadis, 10.3 and 38.5% in Gursum, and 7.2 and 47.8% in Goro gutu during both the dry and wet seasons respectively followed by cut-and-carry feedings, 6.8 and 22.2% in Fadis, 9 and 11.2% in Gursum and 26.0 and 28.6% in Goro gutu in both seasons (Table 4) which was consistent with Dugassa (2021) reported Cut and carry feeding and Tethering in East and West Hararghe zones. A similar survey by Bikila and Tigist (2016) found that in the Haramaya district majority of the respondents (73%) utilize cut-and-carry (zero grazing). In all study districts tethering was more practiced during the rainy seasons of the year and less in dry seasons and cut and carry supplying was done in wet seasons when the natural pastures and trees are abundant which is higher in Goro gutu following availability and its ecology. Nonetheless, the crop residues, kitchen overleft, and

concentrate feeds were supplied in limited amounts during the dry seasons.

In terms of grazing pattern, the interviewed households had utilized 91 and 99.1% of private (kalo) grazing land in Fadis during dry and wet seasons, whereas, 84.1 and 63.3% in Gursum, 94.6 and 86.5% in Goro gutu in both seasons respectively. The rest proportion was shared with communal grazing (9 and 0.9% in Fadis, 14.9 and 35.7% in Gursum, and 5.4 and 13.5% in Goro gutu) in dry and wet seasons. Moreover, animals are privately grazed and were normally tethered both during the dry and wet seasons because of the growth of agricultural land and the restricted communal grazing (Goro gutu and Fadis), and because this study found that cattle herding was rarely done during dry seasons except in Gursum pastoral areas.

Generally, in the study areas, natural pastures were the major feed resource available though, it was continuously grazed (degrading issues were there). During the wet season (June-August) local cattle depend on natural pastures while during the dry season (December-February) they mainly depend on conserving hay and crop residues available after crop harvest. It was reported that during the wet season pastures are abundant, and is when kalos (open enclosures where animals were kept) are full of mud

and the animals (young and adults) spend the whole day in the kalo while standing. In dry season usually oxen gain weight because of limited draft work and the presence of crop residues and they were used for fattening during this season (Fadis and Goro gutu).

Results from the three surveyed districts show that supplementation using commercial feeds (high energy and protein concentrates) was rarely supplied in Goro gutu except in Fadis (4.4%) and Gursum (11.1%), implying the availability and affordability issue was the matters. Young calves (< 3 weeks) were usually tethered and left around homesteads. The cattle's primary source of water was always dams or reservoirs (ponding) water (48.3 and 39.6%; 60.5 and 90.2%; 52.6 and 46.9% in Fadis, Gursum, and Goro gutu during both dry and wet seasons) respectively which was more available and utilized during the rainy

seasons and the water wells or pumps was provided (41 and 21.6%; 39.5 and 9.8; 36.9 and 42.7% in Fadis, Gursum, and Goro gutu) in both dry and wet seasons respectively. This implies artificial ponds and water wells were man-created and not easy to afford for farmers and had a resource limit and less ease for supplying cattle at Adlib due limited number of springs. Besides, Households in the study areas commonly agreed that the stimulant crop and livestock were a crucial and main source of cash if there was a consistent water supply. This asset creates a visible wellbeing difference between those who have it and not (Shumetie and Mamo, 2019). Overall, water sources from dams/reservoirs and water pumps had the major contribution for local Hararghe highland cattle in dry and wet seasons.

Table 4: Sources of animal feed and watering systems in the study areas

Parameters	Fadis (N= 56)		Gursum (N= 56)		Goro gutu N= 56		Prob>X ²
	Dry season (%)	Wet season (%)	Dry season (%)	Wet season (%)	Dry season (%)	Wet season (%)	
Communal grazing land	9	0.9	14.9	35.7	5.4	13.5	0.2303
Private grazing land	91	99.1	84.1	64.3	94.6	86.5	
Grazing aftermath	12.4	-	8.3	12.6	17.8	-	
Grazing fallow land	15.1	34.5	20.2	37.7	13.8	23.6	
Crop residue	17.1	-	28.2	-	18.5	-	
Cut grass and browses	6.8	22.2	9.0	11.2	26.0	28.6	
Tethering	37.1	43.3	10.3	38.5	7.2	47.8	0.2133
Concentrate	4.4	0	11.1	-	-	-	
Hay	7.1	0	11.9	-	16.7	-	
Water	*		**		***		
Lake	10.7	38.9	-	-	-		
Artificial water Reservoirs (ponding)	48.3	39.6	60.5	90.2	52.6	46.9	
River	-	-	-	-	10.5	10.4	
Water well	41	21.6	39.5	9.8	36.9	42.7	

4.3.2. The common health-related problems and health services

Keeping the sanitary of animals and their house is one of the herd health management techniques (Tsadkan Zegeye, 2012). Prevalence status and their response and agents of the local common cattle diseases in all

study districts are indicated in Table 5. The major prevalent diseases described by respondents in Fadis according to index ranking order were Pasteurellosis (0.21), Mastitis (0.20), Brucella (0.17), Skin disease (LSD) (0.16), Ecto-parasite (0.13), and Blackleg (0.12), ranked first, second, third, fourth, fifth and sixth respectively, whereas, Skin disease, Mastitis,

Pasteurellosis, Ecto-parasite, Brucella and Blackleg were most prevalent in Gursum, while pasteurellosis, Skin disease (LSD), Ecto-parasite, Mastitis, Blackleg, and Brucella were widely assessed in Goro gutu according to their importance, and locally known (Abba gorba, gatachuu, dhibee gogaa, Jirgo, maxxantoota), Table 5. Therefore, the distribution and the status of their load of these common diseases varied according to the ecologies with varying proportions or levels. Many of these diseases were outbreaks due to managemental, nutritional table (through feed and water problems) seasons of the year changes, etc. This result was consistent with the study of Guyo (2016) and Shitahun (2009) which found that the main cattle diseases in the Bonke and Bure districts were blackleg, pasteurellosis, foot-and-mouth disease, trypanosomiasis, anthrax, and others.

Elderly residents from the area participated in focus groups, and it was revealed that these diseases mainly affect animals during the brief rainy season (March to May), when their welfare is low because feed was inaccessible during the previous dry season. On the other hand, it was noted that external parasite infestation peaked during the rainy season of the year. Hence, as to the findings of a group discussion with local elders, each kebele needs to build an effective health extension service to address animal health issues. The district's sole source of animal health services was a government operation. Experts employed by the government provided the services, including vaccination at the time of critical disease breakout and the treatment of sick animals. Seldom were deworming, sprays against ectoparasites, and diagnoses carried out with less regular.

Table 5: Prevalence status of common livestock diseases and health services in the study areas

Districts	Parameters		1 st R	2 nd R	3 rd R	4 th R	5 th R	6 th R	Index	Rank
Fadis	Name of local diseases	Blackleg	24	13	14	4	0	1	0.12	5
		Brucella	21	10	13	6	2	4	0.17	3
		Mastitis	14	11	9	12	6	4	0.20	2
		Ecto-parasite	31	10	9	6	0	0	0.13	6
		Skin diseases	23	16	9	8	0	0	0.16	4
		Pasteurellosis	10	9	12	18	6	1	0.21	1
Gursum		Blackleg	21	15	14	4	0	1	0.14	6
		Brucella	18	5	13	8	0	4	0.15	5
		Mastitis	18	11	10	11	6	0	0.18	2
		Ecto-parasite	26	5	13	8	0	4	0.16	4
		Skin diseases	20	10	9	4	13	0	0.19	1
		pasteurellosis	15	18	12	4	6	1	0.17	3
Goro gutu		Skin diseases	23	8	9	9	7	0	0.18	2
		Ecto-parasite	13	10	21	6	2	4	0.17	3
		Blackleg	12	11	9	14	6	4	0.15	5
		Brucella	10	9	31	6	0	0	0.14	6
		Mastitis	13	27	11	4	0	1	0.16	4
		pasteurolosis	11	8	13	17	6	1	0.20	1
Fadis	The Service provided by local gov't extensions	Vaccination	0	15	11	0	0	0	0.49	1
		Treatment	25	20	11	0	0	0	0.42	2
Gursum		Vaccination	25	25	6	0	0	0	0.40	2
		Treatment	20	15	8	10	5	0	0.60	1
Goro gutu		Vaccination	40	10	6	0	0	0	0.40	2
		Treatment	30	10	9	0	2	5	0.60	1
Fadis	Stakeholders	Agricultural offices	16	8	14	12	4	2	0.52	1
		Private veterinary	12	23	9	5	6	1	0.48	2
gursum		Agricultural offices	14	10	15	11	4	2	0.49	1
		NGO	6	2	3	0	0	1	0.08	3
		Private veterinary	12	23	9	7	4	1	0.44	2
Goro gutu		Agricultural offices	20	8	10	12	6	0	0.50	1
		Private veterinary	15	20	7	7	4	3	0.50	2

4.5.3. Cattle Housing

Good shelter can improve the welfare of the animals and reduce production losses. Cattle without shelter need to put more energy into normal functioning and less into production (CSG, 2023). Accordingly, the housing practice of local Hararghe highland cattle in all production systems was mainly constructed inside and the expansion of the main house or the family main house and rarely enclosures without a roof. The majority of farmers interviewed indicated that they were provided a shelter with constructed inside the main house (42.9% Fadis, 57.2% Gursum, and 55.4% Goro gutu), whereas, the expansion of the main house was, 44.6, 21.4, and 32.1% respectively. As the number of livestock held per household was limited, stallholder farmers used the housing their cattle kept with their

main house, and its expansions varied according to each district. The different animal species were housed together; sheep and goats 53.6% Fadis, 66.1% Gursum, and 67.1% Goro gutu whereas, cattle and equine were housed together more at Goro gutu than the rest because of limited homestead as lands were encroached by crop production, Table 6). The calves (<3 months) were separated from their dams during the day and evening times except for milking reasons to prepare animals for the subsequent morning milking and stayed backyard homestead during the day time though it could not under estimated number of farmers who did not separate their calves (>6 months) to cows. They allow their calves to go for grazing with adult cattle after 3 months of age as milking is rarely done especially from the age of 6 months.

Table 6: Housing system of cattle and their types in the study areas

Type of house provided and their systems		Fadis N=56 (%)	Gursum N=56 (%)	Goro gutu(N=56) (%)	Prob>X ²
The Do you separate calve with cow	Yes	91.1	92.9	98.2	0.2425
	No	8.9	7.1	1.8	
Type of shelter provided for the herd	No Shelter	-	-	-	
	A separate house for a herd for each spp.	3.6	14.3	10.7	
	A shelter was constructed inside the house	42.9	57.2	55.4	
	shelter constructed expansion of the main house	44.6	21.4	32.1	
Species of Animals housed together	Cows + calves	8.9	-	-	
	Cattles+ equines	28.6	26.8	31.1	
	Sheep + goat	53.6	66.1	67.1	

4.5.4. Culling

In animal breeding, culling is the process of removing or segregating animals from a breeding stock based on a specific trait (WF, 2023). This is done to exaggerate desirable characteristics or to remove undesirable characteristics by altering the genetic diversity of the population. In general, culling has been classified as voluntary or involuntary (Dohoo and Dijkhuizen, 1993). Involuntary culling implies that cows were culled due to disease, injury, infertility, or death. Low yield or cow's surplus to herd requirement are examples of voluntary culling when animals are healthy and the farmer has complete freedom of choice over which cows are removed from the herd. This departure of cows from the herd in all study areas was triggered by age (16.2%), sterility (15.8%), low milk yield (14.2%), and poor mothering ability in female cows

(11.7%) at Fadis, these variable or trait of interest was rarely done at Gursum and cattle were highly culled for poor milk yield (20.5%) as milk is one of the pastoral area's livelihoods. On the other hand, due to death (17.8%), and 13.7% due to less milk yield in Goro gutu rest of the undesirable traits were culled following death (17.8%) and this removal of cattle from the herd were done at the farmers side due to sale (44.0%), exchange (36.0%) and death (12.0%) at Fadis, 62.1, 22.4, and 10.2% at Gursum respectively, whereas more of departed through sale at Goro gutu (42.3%) and evenly culling was practice for all traits at varying proportions among districts and showed fewer significance differences at ($p < 0.05$), Table 7. That means the null hypothesis failed to be rejected at ($\chi^2 > 0.2335$). Therefore, a culling system of the farmers was not significantly varied among districts in the objectives and purpose for culling the cattle.

Table 7: Culling system, type of cattle, and their causes in the study areas

Culling Strategies		Fadis (%)	Gursum (%)	Goro gutu (%)	Prob>X ²
Trends of culling practices	Yes	87.5	89.3	81.8	0.2335
	No	12.5	10.7	18.2	
Reason for culling	Diseased	12.0	10.2	17.8	
	Old age	16.2	14.7	10.8	
	Sterility (female)	15.8	13.4	11.1	
	Poor physical condition	3.5	5.8	12.3	
	Low milk yield	14.2	20.5	13.7	
	Poor mothering ability	11.7	12.2	6.0	
	Bad color	10.3	4.3	3.6	
Means of culling	Poor libido (male)	3.8	8.2	6.5	
	sale	44.0	62.1	42.3	
	Slaughter	7.5	4.8	4.8	
	Exchange	36.0	22.4	34.7	

4.6. Qualitative Characteristics of the Hararghe Cattle Population, both Female and Male

Table 8 lists the qualitative traits of female and male Hararghe cattle. Short and thick horned; the dewlap is well developed; coat colour is mainly black, roan, and red (Rege and Tawah, 1999, DAGRIS, 2023).

The overall summary frequencies of morphological features of Hararghe highland cattle were almost the same on average in all study areas except in Goro gutu which showed a difference in coat color to the rest of the study districts. In female cow populations, white-grey, white, white, and red, black (rare) was the most often seen coat colors. In the studied population of male cattle, white-gray 72.7% was the most prevalent coat color type followed by red (12.1% frequently observed in Goro gutu), white (9.1%), and white and red 1.7% whereas 71.5%, 8.9%, 14.6 and 1.2% respectively in the female sampled population. In coat color pattern, the plain was 85.8% and 90.2% male and female, and the remaining patterns were 4.2% and 2.2% shade; 7.0% and 3.0% spotted female and male respectively. Plain coat color patterns were more frequently seen in the sampled female population. The majority of the sample Hararghe cattle population in the study areas 93.1% female and 84.8% male had pigmented body skin coats, whereas the rest did not. For females, the pigment was present in the muzzle (78.9%), hoof (91.9%), and eyelid (90.7%). Males had pigmented muzzles, hooves, and eyelids to varying degrees 72.7%, 81.8%, and 63.6% respectively.

Females had a 22.0% small, 65.9% medium, and 12.2% large nasal flap. In the sample of males, there were 19.2% small (little), 75.8% medium, and 5.1% large permanent sheaths. The majority 92.7% of the female and over 93.7% of the male cattle in the research areas had horns, whereas 18.2% of the female cow and 6.2% male population were poled out of a sampled population. Among the population of horned male and female cattle, 37.4% were straight, 35.7% were curved, 5.2% were loose, 5.5% were stump horned, and over 7% were polled cattle. Out of the sampled male population, 60.6%, 29.3 and 10.1 had a large, medium, and small hump size and of these cattle, 90.9% rounded from front to back oriented and 9.1 thoracic. The overall sampled cattle population had 66.1% straight and 19.5% concave facial profiles and the rest were in between.

The current finding is very in line with the report of Dugassa (2021) on phenotypic characterization for Harar cattle in Eastern and West Hararghe zones, Jarso, Tullo, Oda bultum and Goro gutu districts and coat colors; male cattle, white-gray (26.2%) followed by red 20.2%, (11.2%) white, (13.1%), and black (6%). The plain 95% and the remaining patterned shade and spotted 5% female and (94% plain and 6% spotted) were male respectively; female (94.1%) and male (92.9%) had pigmented body skin coats, pigmented muzzle (66.3%), hoof (91.1%), and eyelid (11.6%). Males had pigmented muzzles, hooves, and eyelids to varying degrees (64.3, 94, and 21.4%, respectively); (93.3%) of the female and (100%) of the male cattle had horns according to his previous report.

Table 8: Qualitative traits description for indigenous Hararghe cattle in the study area

		Female N=246		Male N=99		Overall N=345	
Variables		N	%	N	%	N	%
Facial profile	straight	186	75.6	84	84.8	228.0	66.1
	concave	60	24.4	15	15.2	67.5	19.5
Dewlap size	Small	88	35.8	10	10.1	93.0	27.0
	medium	146	59.3	64	64.6	178.0	51.6
	large	12	4.9	25	25.3	24.5	7.1
Coat color pattern	plain	185	75.2	79	79.8	224.5	65.1
	Shade/patch	25	4.2	17	2.2	33.5	1.9
	spotted	30	7.0	3.0	3.0	37.5	2.9
Coat color type	Red	22	8.9	12	12.1	28.0	8.1
	white	36	14.6	9	9.1	40.5	11.7
	White grey	176	71.5	72	72.7	212.0	61.4
	White and Red	3	1.2	6	6.1	6.0	1.7
	Black	9	3.7	0	0.0	9.0	2.6
Body coat color	Pigment	229	93.1	84	84.8	271.0	78.6
	Not pigment	17	6.9	15	15.2	24.5	7.1
Muzzle color	pigment	194	78.9	72	72.7	230.0	66.7
	Not pigment	52	21.1	27	27.3	65.5	19.0
Eyelid color	pigment	223	90.7	63	63.6	254.5	73.8
	Not pigment	23	9.3	36	36.4	41.0	11.9
Hoof color	pigment	226	91.9	81	81.8	266.5	77.2
	Not pigment	20	8.1	18	18.2	29.0	8.4
Horn condition	Present	228	92.7	93	93.9	274.5	79.6
	Absent	18	7.3	6	6.1	21.0	6.1
Horn shape	Straight	158	64.2	63	63.6	189.5	54.9
	curved	60	24.4	30	30.3	75.0	21.7
	loose	9	3.7	6	6.1	12.0	3.5
	stump	19	7.7	0	0.0	19.0	5.5
H. Orientation	Pointing laterally	195	79.3	80	80.8	235.0	68.1
	Upward	42	17.1	10	10.1	47.0	13.6
	Downward	9	3.7	0	0.0	9.0	2.6
Ear orientation/shape	lateral	213	86.6	81	81.8	253.5	73.5
	dropping	33	13.4	18	18.2	42.0	12.2
Hump size	Small	196	79.7	10	10.1	201.0	58.3
	medium	50	20.3	29	29.3	64.5	18.7
	Large	0	0.0	60	60.6	30.0	8.7
Hump orientation	Rounded from front to back	176	71.5	90	90.9	221.0	64.1
	Thoracic	70	28.5	9	9.1	74.5	21.6
Perpetual sheath	small	0	0.0	19	19.2	9.5	2.8
	medium	0		75	75.8	37.5	10.9
	large	0	0.0	5	5.1	2.5	0.7
Naval flap (for cows)	small	54	22.0	0	0.0	54.0	15.7
	medium	162	65.9	0	0.0	162.0	47.0
	Large	30	12.2	0	0.0	30.0	8.7

N= Number of breeding female and male cattle

4.7. Quantitative Traits in male and female Hararghe Cattle.

Table 9 provides summary statistics for quantitative characteristics of both male and female Hararghe cattle populations in the study areas. The sex of the animal (on some variables) and the districts had a significant impact on the phenotypic variation in all quantitative dependent variables at ($p < 0.05$). The cows' linear body dimensions between sexes showed that there was a significant difference in all the major variables body length, heart girth, height at rump, and height for the cattle that finished their growth (matured) and were lower in female cattle population and relatively higher in males, Table 9. This might be due to the production stress and physiological adaptation difference between female cattle with males. Whereas linear measures on major variable showed higher, that farmers were owed special management for male cattle and existed between good to average body condition. On the other hand, all ecologies or study districts showed highly significance differences in all major linear measures. Accordingly, the body length of the cattle population at Fadis was higher than the population at Goro gutu and showed lower values than the population of cattle at Gursum, had a higher heart girth than that of Gursum cattle population but less than those in Goro gutu, and showed a lower value in height at rump and height at withers than the rest of the districts. This implied cattle population in this ecology relatively showed longer body and fat body conditions. Furthermore, a morphometrical trait of the cattle population in Gursum (arid – semi-arid areas) showed higher values in the measurable linear body compared with the rest of the study areas Whereas, heart girth was higher than in study areas, but the height at the rump and height at withers was only higher than Gursum cattle populations.

This implies cattle populations in highland areas relatively larger and shorter which is the reverse for the lowland cattle population for physiological adaptations. The current finding was in line with previous reports on the relationship between ecological diversity and body size variation in indigenous cattle populations (Marume *et al.*, 2014), and the authors found that cattle populations in different ecological zones have distinct morphological characteristics, including variation in linear body measures such as height, length, and girth due to the result of natural

selection pressures and adaptation to specific environmental conditions, such as temperature, humidity, and availability of food and water. Therefore, the current finding provides evidence to support the idea that cattle in different ecological environments have differences in their linear body measures according to specific environmental conditions or productions.

Furthermore, the Hararghe highland cattle population was compared to those of other indigenous cattle raised in different parts (ecology) of Ethiopia for their morphometric traits. For instance, the results reported by Habtamu (2017) for the indigenous cattle breed of Benishangul Gumuz, western Ethiopia, had a body length of (149.93 ± 0.68 cm), a chest circumference of (115.49 ± 0.59 cm), and a height at the withers of (120.9 ± 0.70 cm), respectively which were longer and larger in than the current finding. Additionally, (Endashew, 2015) reported that Mursi cattle in the Bodi and Mursi pastoral districts of the south Omo zone, southwestern Ethiopia, had body lengths, chest girths, and heights at the withers that were, respectively, 122.01 cm, 144.5 cm, and 113.0 cm. The current result, however, was less favorable than Mulugeta's (2015) 137.0 ± 0.10 , 136.0 ± 0.09 , 168.9 ± 0.10 and for male Begait cattle, the following measurements, Height at withers; Body length; Chest girth implied that there's a significance difference as well with the northern Tigray of Ethiopia, Begait cattle breed.

However, the current findings were very consistent with those of average measured values for body length, except chest girth (131.53 cm), and height at withers of Horro cattle found to be (99.42 cm), 107.18 cm, respectively, reported by (Dereje and Endashaw, 2015) respectively. The study by Fasil *et al.* (2014) for indigenous female Ogaden cattle, In the Eastern ecology of Ethiopia, near the border of Hararghe plateau, showed lower values for body length (104.1 ± 0.50) except higher in height at withers (113.5 ± 0.39 of ogaden) than the current findings, but higher values for chest girth (149.1 ± 0.66). In the ecology of southern parts of Ethiopia, the findings of Ebadu *et al.* (2017) for Bonga cattle were nearly in line with those of the present study in terms of body length (110.52 ± 0.33 cm), except higher in chest girth (135.04 ± 0.42 cm), and height at withers (100.48 ± 0.29). Implied ecology impacts in variation for linear body dimensions of cattle irrespective of the breed type.

Table 9: The Summary of linear body measurements in female and male Hararghe cattle population

	EL	BL	HG	HR	RL	HW	PW	WFH	NL	TL	MC
Effects		Mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE	mean+ SE
Districts	*	***	***	***	***	***	***	***	**	***	**
Fadis	19.5±0.14 ^a	116.3±1.38 ^b	148.5±1.13 ^b	114.4±1.21 ^b	41.4±0.71 ^a	107.7±0.76 ^b	32.6±0.35 ^a	43.7±0.45 ^a	52.8±0.75 ^b	92±0.84 ^a	33±0.30 ^a
Gursum	19±0.15 ^{ab}	123.2±1.44 ^c	145.6±1.22 ^b	122.5±1.31 ^b	41±0.74 ^a	115.7±0.79 ^b	28.7±0.37 ^c	22±0.47 ^c	52±0.78 ^b	81.3±0.91 ^c	31.5±0.31 ^b
Goro gutu	18.9±0.15 ^b	110.3±1.42 ^a	152±1.22 ^a	115.7±1.25 ^a	27.5±0.73 ^b	109.6±0.78 ^a	30.6±0.36 ^b	23.7±0.47 ^b	55.5±0.77 ^a	84.5±0.86 ^b	30.6±0.31 ^b
Sex	ns	***	**	**	ns	*	**	ns	ns	**	ns
Female	19±0.11 ^a	115.7±0.93 ^a	150.5±0.76 ^b	116.6±0.82 ^a	36.5±0.51 ^a	107±0.51 ^a	30±0.24 ^b	29.4±0.30 ^a	53.5±0.50 ^a	85±0.57 ^b	31.9±0.20 ^a
Male	19±0.15 ^a	120.8±1.47 ^a	153.5±1.21 ^a	118.7±1.31 ^a	37±0.75 ^a	109±0.81 ^a	31.7±0.38 ^a	31±0.48 ^a	53.5±0.81 ^a	88±0.91 ^a	31.8±0.32 ^a
District*Sex	ns	ns	ns	ns	*	ns	ns	*	ns	ns	ns
F,Fadis	19.6±0.21 ^a	115.2±1.70 ^{bcd}	147.1±1.40 ^b	113.2±1.35 ^c	40.7±0.87 ^a	104.0±0.94 ^b	32.1±0.44 ^a	43.6±0.56 ^a	52.8±0.93 ^a	92.0±1.03 ^a	33.7±0.37 ^a
M,Fadis	19.3±0.23 ^{ab}	118.1±2.25 ^{abc}	150.8±1.85 ^b	116.1±1.79 ^{bc}	42.5±1.15 ^a	103.0±1.23 ^b	33.3±0.58 ^a	44.0±0.74 ^a	52.7±1.22 ^a	92.5±1.37 ^a	32.9±0.49 ^{ab}
F,Gursum	18.9±0.21 ^b	110.3±1.54 ^d	144.8±1.27 ^b	115.0±1.23 ^c	41.1±0.79 ^a	102.4±0.85 ^b	28.4±0.41 ^c	22.56±0.51 ^{bc}	52.4±0.84 ^a	80.8±0.94 ^c	31.6±0.34 ^{bc}
M,Gursum	19.0±0.31 ^{ab}	1109.8±2.85 ^{cd}	148.5±2.35 ^b	117.3±2.30 ^{abc}	41.2±1.46 ^a	103.6±1.57 ^b	29.4±0.74 ^{bc}	21.1±0.94 ^c	51.8±1.55 ^a	82.8±1.74 ^{bc}	31.2±0.62 ^{bc}
F,Goro gutu	19.2±0.21 ^{ab}	115.2±1.59 ^{ab}	159.6±1.31 ^a	122.4±1.26 ^a	28.1±0.81 ^b	115.4±0.87 ^a	30.2±0.41 ^b	24.2±0.52 ^b	55.4±0.86 ^a	83.4±0.97 ^{bc}	30.5±0.35 ^c
M,Gorogutu	18.95±0.27 ^{ab}	127.3±2.9 ^a	161.3±2.15 ^a	123.4±2.10 ^{ab}	26.2±1.34 ^b	116.2±1.44 ^a	31.4±0.67 ^{ab}	22.5±0.86 ^{bc}	56.0±1.42 ^a	87.7±1.59 ^{ab}	30.7±0.57 ^c
Overall mean	19.1±0.14	116.86±1.33	151.6±1.12	117±1.18	36.7±0.69	107.2±0.73	30.7±0.34	30±0.43	53.5	86±0.82	31.8±0.31
CV	8	13.29	8.9	14.44	26.91	9.22	13.36	36.5	14.9	11.6	10.6
R ²	0.09	0.31	0.56	0.54	0.68	0.62	0.32	0.88	0.55	0.61	0.18

Note: ns = not significant ; EL: Ear length; HG: Heart girth; HR: Height at rump; HW: Height at withers; PW: Pelvic width; WFH: Width of forehead; NL: Neck length; TL: Tail length; MC: Mouth circumference; a, b = means with different letter superscript across the column differ significantly; SE = standard error; CV: coefficient of variation; R²: Amount of y expressed by categorical variables (x factors) error; N = Number of respondents; *** = significant at (p < 0.001); ** = significant at (p < 0.01); * = significant at (p < 0.05)

5. Major Challenges and Constraints in the Study Areas

Before starting any genetic improvement effort, it was fundamentally important to take into account the relative importance of the various restrictions for cattle production (Mulugeta, 2015). It is essential to first identify the barriers preventing cattle from being produced and productive before beginning any genetic improvement programs in any production system (Dereje, 2015) cited in reports of Dugassa (2021). The lack of improved pasture (feed and water), disease and parasite, genotype, lack of credit service, lack of improved forage, and frequent drought were identified as the top six problems however, most importantly, Feed and water (quantity and quality) had an index ranking values of 0.18, 0.21, and 0.20 at *Fadis*, *Gursum* and *Goro gutu* respectively identified as a scarcity of animal feed as the primary important problem followed by Livestock disease (0.16, 0.19, and 0.18) and genotype (0.15, 0.16 and 0.15) were the main obstacles limiting the productivity of farmers in all study districts. Erratic rainfall was also mentioned for the lack of feed and water. This result is consistent with the observation of Tessema (2003) that seasonal fluctuations in feed quality and quantity are the primary constraints of animal production and induce variability in productivity throughout the year, particularly in the dry seasons when feed is scarce.

The report of Yadeta (2018) which listed infections, a lack of water, and a lack of feed as the top three issues in Fentale and Boset districts of the east Shoa zone, Oromia regional state, respectively, provided support for the current outcome. For Begait cattle, Mulugeta (2015) indicated that the most significant difficulties were lack of feed, illnesses, and water deficit, which were ranked first, second, and third with various index values, respectively. Additionally, the results of the current study concur with those of Yisehak *et al.* (2013) who reported that in the Jimma zone of southwest Ethiopia, the problem of a lack of feed supply was ranked first, followed by the problem of animal diseases, and with those of Genet *et al.* (2017), who reported that in the east Shoa zone, a lack of feed, a lack of water, issues with marketing, and issues with animal health were the main obstacles to running fattening operations at all levels of production.

In general, the limitations seen in the research area included the lack of better feed, the absence of better breeds of cattle, market issues, a lack of credit services, insufficient veterinary services in the area, and a lack of extension services. According to key informants and elders, the lack of feed in research regions was mostly caused by the reduction of grazing pasture owing to cultivation, environmental degradation, and the rising human population.

Table 16: Major constraints of Cattle production ranked in the order of their importance in the study areas

Districts	Parameters	Ranks							Index	Rank
		1st	2nd	3rd	4th	5th	6th	7th		
Fadis	Feed and water scarcity	6	7	10	7	5	7	14	0.18	1
	Ls disease	10	8	8	8	8	7	7	0.16	2
	Genotype	8	12	11	4	6	7	8	0.15	4
	Poor market	12	13	10	12	5	0	4	0.12	7
	Lack of credit service	12	6	8	15	8	2	5	0.14	6
	Lack of improved forage	10	9	9	7	7	9	5	0.15	5
	Drought	8	10	9	8	7	8	6	0.16	3
Gursum	Feed and water scarcity	2	5	10	7	5	10	17	0.21	1
	Ls disease	6	9	7	9	0	11	14	0.19	3
	Genotype	6	14	10	7	5	7	7	0.16	4
	Poor market	18	15	8	5	7	2	1	0.11	7
	Lack of credit service	15	15	11	8	4	0	3	0.11	6
	Lack of improved forage	12	8	7	11	10	3	5	0.15	5
	Drought	5	10	7	10	10	8	10	0.19	2
Goro gutu	Feed and water scarcity	4	7	12	5	0	13	15	0.20	1
	Ls disease	9	6	8	8	6	5	14	0.18	2
	Genotype	14	6	11	6	7	6	6	0.15	3
	Poor market	16	17	10	3	6	3	1	0.11	7
	Lack of credit service	9	13	10	9	4	5	6	0.15	4

6. CONCLUSION

The study was conducted in three districts (Fadis, Gursum, and Goro gutu) in the East Hararghe zone, Oromia Regional State, Ethiopia, with the objectives to phenotypically characterize of local cattle population and to characterize the breeding, and husbandry practices of Hararghe cattle in the study areas. Data collection was carried out using a semi-structured questionnaire, focus group discussions, discussion with key informants, field observations, and measurement of quantitative and qualitative traits. Moreover, secondary data was collected from different sources and used in the study. Totally 345 heads of Hararghe cattle (246 female and 99 male) kept in an on-farm system were successfully characterized for morphological and morphometrical traits at their population level. The result of the study revealed that the majority of respondents were male-headed households (92.9%). The most important source of household income was from mixed crop-livestock production (66.7%).

The overall mean livestock holding per household were 5.91 ± 0.35 , 7.46 ± 0.47 , 3.78 ± 0.27 , 1.72 ± 0.11 and 13 ± 0.58 cattle, goats, sheep, donkey, and chicken, respectively. The coat colour of cattle was white grey, white, and red in females and white grey, and white, white, and red in males. The size of the hump varies from small to large in male cattle. Whereas horns are curved and straight. The polled was (7.3%) in females and (6.1%) in males. Ear shape is straight-edged and laterally oriented. The dewlap is medium and straight facial profile. Perpetual sheaths for bulls are small to medium and naval flaps for cows are also small to medium. The male Hararghe cattle possess large hump sizes (60.6%) and medium (29.3%), while the majority of female cattle possess small hump sizes (79.7%). The average Body length (116.3 ± 1.38), Heart girth (148.5 ± 1.13), Height at rump (114.4 ± 1.21), Height at withers (107 ± 0.76), Neck length (52.8 ± 0.75), and Mouth circumference was (33 ± 0.30) at Fadis which varied from 123.2 ± 1.44 BL, 145.6 ± 1.22 HG, 122.5 ± 1.31 HR, 115.7 ± 0.79 HW, 52 ± 0.78 NL, and 31.5 ± 0.31 cm MC at Gursum and 110.3 ± 1.42 , 152 ± 1.22 , 122.7 ± 1.25 , 109.6 ± 0.78 , 55.5 ± 0.77 , 30.6 ± 0.31 years, at Goro gutu respectively, with a body weight of (265.27Kg for those less than 5 years) female cattle which was 268.24Kg for male cattle for those less than five years. For female Hararghe cattle age at first mating, age at first calving, calving interval, reproductive lifetime of cow and total calves born per cow lifetime were 3.66 ± 0.06 , 3.96 ± 0.12 , 1.87 ± 0.03 , 12.6 ± 0.4 and 4.68 ± 0.12 years respectively. In the study areas, Tethering feed practice was 37.1 and 43.3% in Fadis, 10.3 and 38.5% in Gursum, and 7.2 and 47.8% in Goro gutu during the dry and wet seasons respectively followed by cut-and-carry feedings, 6.8 and 22.2% in Fadis, 9 and 11.2% in Gursum and 26.0 and 28.6% in Goro gutu in both seasons. The majority of respondents (61.7%) utilize primary water from dams or reservoirs (ponding) (48.3 and 39.6%; 60.5 and 90.2%;

52.6 and 46.9% in Fadis, Gursum and Goro gutu during both dry and wet seasons) respectively whereas water wells (spring) or pumps (41 and 21.6%; 39.5 and 9.8; 36.9 and 42.7% in Fadis, Gursum and Goro gutu) in both dry and wet seasons. The majority of respondents kept their animals (inside the main house) (42.9% Fadis, 57.2% Gursum, and 55.4% Goro gutu), whereas, the expansion of the main house or homestead shades (44.6, 21.4, and 32.1% respectively in all districts. The major prevalent diseases described by respondents in Fadis according to index ranking order were pasteurellosis (0.21), mastitis (0.20), brucella (0.17), Skin disease (LSD) (0.16), ectoparasite (0.13), and blackleg (0.12), ranked first, second, third, fourth, fifth and sixth respectively, whereas, skin disease, mastitis, pasteurellosis, ectoparasite, Brucella and Blackleg was prevalent in Gursum while pasteurellosis, skin disease (LSD), ectoparasite, Mastitis, Blackleg, and Brucella widely assessed in Goro gutu according to their importance.

The major challenges that faced the cattle farmers in the study areas were shortage of feed and water, disease and parasites, genotype, and lack of credit service identified as the major problems that deferred cattle productivity in the study areas. Generally, phenotypic qualitative characteristics of the Hararghe cattle populations are alike, while their quantitative characteristics in the three districts revealed that cattle populations of Fadis and Gursum are closer than that of Goro gutu which could be because of proximities. The linear body measurement results showed that Harar cattle are larger compared to other cattle like Gamo-gofa cattle, Arsi cattle, and Mursi cattle. Production system characterization revealed that cattle are mainly used for fattening purposes (37.3%). Based on the results of the present study the following recommendations are forwarded:

- Further on-station study should be employed to characterize and investigate the trait of production that will be used in selecting the best and enhancing in improvement and conservation program
- Further study should be conducted on molecular characterization and reproductive performance traits of Hararghe cattle type.
- The major serious problem in cattle fattening is the availability and quality of feed, therefore, there should be a strategy for improving animal feeds by introducing feed processing technologies. Additionally, proper feed conservation enhancement of crop residues and improved fodder cultivation should be also considered.
- Developing natural resource conservation mechanism improve the availability of water in the areas

CONFLICT OF INTEREST

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