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Equine husbandry, reproduction performance and welfare practices in Gozamin District, East Gojjam Zone, Ethiopia

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Abstract

Equines have made significant contributions to economic development worldwide, including Ethiopia. However, people often underestimate their socioeconomic importance, and they confront various challenges that threaten their welfare and health. This study aimed to assess existing equine husbandry, reproductive performance, and welfare practices in Gozamin District, East Gojjam Zone, Ethiopia. Data were collected through face-to-face interviews with 230 smallholder farmers. The results indicated that owners primarily kept their equines for packing (39.1%), followed by ploughing and packing (22.2%) and riding and threshing (10%). Across all agroecologies, the primary feed and water sources for equines were natural pasture (53.9%) and surface water (65.5%). Equines were typically reared in separate, barren shelters (68.7%). The average age of sexual maturity for horses and donkeys was 2.29 ± 0.05 years and 2.16 ± 0.03 years, respectively. The average mating interval for both donkeys and horses after delivery was 34.43 ± 0.53 days. The major welfare problems were poor accessibility of forage (47.8%) and water (30.1%), physical health problems (29.7%), and regular physical contact (61.6%). The study indicated a significant variation ($p<0.05$) in the purpose of equine milk across different agroecologies, except for the utilisation of milk. There is significant difference ($p < 0.05$) in feed and water availability, housing, harnessing, disease-related concerns, and most of reproduction factors across agroecologies. This study demonstrated only a significant variation ($p < 0.05$) in the comfort/housing of equines across different agroecologies through various welfare variables studied. The overall husbandry of equines, including their feed and feeding practices, was found to be inadequate. To improve equine production and welfare, it is crucial to enhance owners'

knowledge through consistent and organised training programs. Therefore, governmental and non-governmental organisations should prioritise addressing the needs of neglected equines to alleviate these issues.

Keywords: Equine, Gozamin, Husbandry, Reproduction performance, Welfare

Introduction

Equines play a vital role in global economic development by transporting food, fuel, and agricultural inputs, as well as providing draft power (Asmare and Yayeh, 2017). In developing countries, they are utilized for various tasks, including plowing, carting, packing, and occupational therapy. This versatility alleviates transport burdens and generates income for many rural communities (Fitsum and Ahmed, 2015). Working equines supply over 50% of agricultural energy for traction, significantly exceeding the contribution of internal combustion engines, which account for less than 30% (Gelaye and Fesseha, 2020). In response to rising fuel prices, many urban workers in countries like Pakistan and India are shifting from motorized vehicles to equine-powered carts (Brooke, 2009). In numerous developing nations, equines are essential for livelihoods, often serving as the sole income source for their owners (Herago et al., 2015; Moltumo et al., 2020).

However, in many developing countries, equines are often neglected in resource allocation, particularly in the poorest communities (Guyo et al., 2015). This neglect is evident in the inadequate provision of basic necessities like shelter, water, and feed. Only a small percentage of owners provide water (4.38%) and feed (10.5%), and almost none provide shelter at working sites. This lack of care, coupled with long working hours and inadequate rest, negatively impacts equine production and welfare (Solomon et al., 2016; Mekuria et al., 2013). Despite their significant contributions to communities and the national economy, attention to studying the health, production, and welfare problems of equines in Ethiopia remains minimal (Usman, 2015). Equines often work long hours and, when not working, are left to forage on garbage, further compromising their health. This lack of proper care and veterinary attention significantly contributes to the premature death of working equines. In contrast, equines in countries with well-implemented animal welfare practices can live up to 30 years (Fred and Pascal, 2006; Arega et al., 2023).

Over the past few decades, several studies have been conducted on the socio-economic importance, management, health, and welfare of equines in Ethiopia. These studies carried out in

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various locations including Sebeta Town and Suburbs in Central Ethiopia (Arega et al., 2023); Debre Berhan town (Gelaye and Fesseha, 2020); selected areas of Awi Zone (Asmare and Yayeh, 2017); Adet Town (Seyoum et al., 2015); Mekelle city (Kumar et al., 2014); Hawassa town (Mekuria et al., 2013) have highlighted the diverse uses of equines, including packing, carting, and various social activities. Major constraints identified in these studies include diseases, feed shortages, and water scarcity (Gelaye and Fesseha, 2020).

Despite the significant numbers and growing importance of equines in the Ethiopian economy, particularly in the Gozamin district (Gelaye and Fesseha, 2020), governmental and non-governmental organizations have given markedly insufficient attention to equine welfare and production. To the authors' knowledge, equine production practices and the associated constraints in the Gozamin district have not been thoroughly investigated. This lack of research may stem from a limited focus on equine-related studies and inadequate funding for equine issues. Furthermore, equines are often overlooked compared to other livestock species, leading to neglect of their welfare and production needs. Thus, this study aims to assess the current state of equine husbandry, reproductive performance and identify the major welfare problems affecting these animalsin the Gozamin district, Ethiopia.

Materials and methods

Study area

The study was conducted in Gozamin district, East Gojjam Zone, Amhara National Regional State, Ethiopia. Gozamin district is located 305 km northwest of Addis Ababa. The geographical location of the district is between latitude and longitude of 10°20′- 10°333′ N and 37°43′- 37°717′ E, respectively. The district is found with an altitude range of 1200–3510 m.a.s.l. (GWAO, 2018). Based on the altitude difference, the district has three agro-ecological zones, namely highland, midland, and lowland. The district has 1,628 mm of average annual rainfall. The mean annual minimum and maximum temperatures are 11°C and 25°C, respectively. Agriculture is the mainstay of the livelihood of people and the leading economic activity of the area, with a mixed farming system covering 80% of the total agricultural activities with crop-livestock production (GWLA, 2018).

Study populations

The study population consisted of smallholder farming households in the Gozamin district who owned at least one equine. A total of 11,983 farmers (7,442 males and 4,641 females) were engaged in equine production in the district. The district is highly conducive to equine production, featuring diverse agroecological zones that encompass highlands, midlands, and lowlands. Horses, donkeys, and mules are found throughout most of the district, with a population of 29,513 donkeys, 17,457 horses, and 521 mules. The production and management systems in the study area are traditional, and the genetic makeup of the equine species is not well-defined. The majority of the donkey population is found in the lowland areas, while the horse population is concentrated in the highlands. Mules, on the other hand, are adaptable to all agroecological zones within the Gozamin district (GWLA, 2018).

Study design and sampling technique

A cross-sectional study was conducted in purposely selected peasant associations (PAs) of the Gozamin district. All the 25 rural PAs in the district were grouped into three based on agroecology, and then nine, eleven, and five were selected from highland, midland, and lowland, respectively. From each agro-ecology, two PAs were selected by simple random sampling. Households were selected using a systematic random sampling technique with ten intervals. Questionnaires were administered to equine owners to collect relevant information.

Participation in the survey was voluntary and required participants to own at least one equine to meet the inclusion criteria. The sample size was determined based on the variance of key indicator variables using a proportionate probability sampling technique in accordance with Cochran's sample size formula (Cochran, 1977).

$$n_o = \frac{Z^2 pq}{e^2}$$

In this formula, *no* represents the sample size, *z* is the selected critical value corresponding to the desired confidence level, p is the estimated proportion of an attribute present in the population, $q = 1-p$, and e is the desired level of precision. Assuming 50% variability in the key indicator variables (with $p = 0.5$) and a 95% confidence level with ±5% precision, the required sample size was calculated to be 384 households.

Although the total number of smallholder farmers with at least one equine in the study district was approximately 11,983, only 572 households were considered for sample size determination.

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This selection was based on factors such as accessibility, respondents' willingness, and logistical feasibility. Given that the number of households across all study agroecologies was finite, the sample size was recalculated using Cochran's formula for finite populations:

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Where $n0$ is the sample size from an infinite population (384) and N is the total population size (572). Using this correction formula, the adjusted final sample size (n) was determined to be 230 smallholder farmers.

Data collection

The data was collected from primary and secondary sources with pre-tested questionnaires and some corrections were made to improve the relevance of the question for the study. The primary data was obtained through face-to-face interviews (households, focus group discussions, and key informants) and field observations (housing type, clinics, purposes, and species distribution). The primary data was collected by using questionnaires on the existing socio-economic characteristics, the main purpose of keeping equine and its constraint of production were collected.

From each selected PA, a group of 7 to 9 members of model farmers were selected purposely to discuss equine production and welfare practices. From each selected PA, two to four key informants (livestock experts and veterinarians) were selected and interviewed about common diseases, breed type of the equine, death rate of the equine, extension system, and disease control methods. Secondary data was collected (about livestock population, agroecology, geographical location, and population size) from the district's livestock and fisheries office and development agents.

Data management and analysis

The collected data was analyzed by using SPSS version 25. The chi-square test was employed to compare categorical variables such as the role of equine, feed and water source, use of harness, welfare issues, and death rate of equine. Quantitative data like life expectancy of equines, number of foul deliveries, mating interval, gestation length, and sexual maturity of equines were analyzed by using ANOVA to compare results (p<0.05). The index was used to provide an overall ranking

of a specific trait using an excel sheet. The formula for calculating the index is as follows: Index = (sum of scores for individual traits) / (sum of scores for overall traits). Scores are assigned as follows: 3 points for rank 1, 2 points for rank 2, and 1 point for rank 3 (Kosgey, 2004). Data from focus group discussions (FGD) and key informant interviews (KI) were analyzed in accordance with the methodology outlined by Onwuegbuzie et al. (2009).

Results and discussion

Socio-economic characteristics of the households

In this study, the majority of equine owners in the district were male-headed (93%) across all agroecologies (Table 1). The male-headed household characteristic of respondents in this district aligns with the findings of Asmare and Yayeh (2017); Asmare et al. (2016) and Wolelie et al. (2016) in different parts of Ethiopia. Furthermore, this finding aligns with the research of Pearson et al. (2001), which indicates that while women owning donkeys is not uncommon across various societies, men primarily own and control these animals. This observation, however, contradicts the results reported by Bwalya (1998), which found that most donkeys are owned by women who use them for agricultural tasks and household chores.

Table 1.Socio-economic characteristics of respondents in the study district

Parameters (%)		Highland (NR = 83)	Midland (NR = 73)	Lowland (NR = 74)	Total mean (NR = 230)
Sex	Male	95.2	95.9	87.8	93
	Female	4.8	4.1	12.2	7
Age	< 30 years	0.0	4.1	2.7	2.2
	30-40 years	15.7	27.4	33.8	25.2
	41-50 years	43.4	39.7	39.2	40.8
	51-60 years	33.7	24.7	21.6	27.0
	> 60 years	7.2	4.1	2.7	4.8
Educational	Illiterate	43.4	28.8	36.5	36.5
Status	Read and write	30.1	42.5	25.7	32.6
	<Grad 8	22.9	26.0	33.8	27.4
	>Grad 8	3.6	2.7	4.1	3.5

NR = Number of respondents

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Additionally, the majority of equine owners in this district were aged between 41 and 50 years. The results of this study are similar to the reports of Asmare and Yayeh (2017); Asmare et al. (2016) and Solomon et al. (2014), who reported an average age of 43.2 ± 1.0 years. Regarding education levels, the highest percentage (36.5%) of respondents were illiterate (Table 1). The educational characteristics of horse owner respondents were largely consistent with earlier reports in Ethiopia (Asmare and Yayeh, 2017; Asmare et al., 2016; Wolelie et al., 2016) from different districts. High illiteracy rates can negatively impact livestock production, as farmers may be less likely to adopt new technologies for management.

Purpose of equine production

The study revealed significant variations ($p<0.05$) in the primary purposes of equines across different agroecologies. In lowland areas, equines were primarily used for plowing and packing. In midland areas, they were used for riding, packing, and carting. In the highland areas, equines were reared for threshing, riding, packing, plowing, and carting. This study highlights the diverse roles of equines in the study area (Table 2). This finding is also consistent with earlier reports of Asmare and Yayeh (2017); Wolelie (2016) and Fitsum and Ahmed (2015), who reported that equines can be used for various roles, such as transporting goods by pack and cart due to their sturdy nature and manageable behavior. Gebreab et al. (2004) documented the positive impact of equines on reducing the burden on women, particularly in relation to headload transport and time spent searching for food and water in different parts of Ethiopia. Packing and threshing were more common in highland areas compared to midland and lowland areas. This could be attributed to farmers in highland areas having smaller livestock populations per household.

Table 2. Purpose of equine production across different agroecologies

Purpose of Equine Production (%)		Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)	*p*-value
Packing only		16.9[c]	68.5[a]	35.1[b]	39.1	0.000
Carting only		6.0[a]	5.5[a]	0.0[b]	3.9	
Plough, packing and threshing		25.3[a]	0.0[b]	0.0[b]	9.1	
Packing and threshing		13.3[a]	5.5[a,b]	0.0[b]	6.5	
Riding only		4.8[a,b]	11.0[a]	0.0[b]	5.2	
Plough and packing		3.6[b]	0.0[b]	64.9[a]	22.2	
Packing and carting		2.4[a,b]	9.6[a]	0.0[b]	3.9	
Packing, riding and threshing		27.7[a]	0.0[b]	0.0[b]	10.0	
Use of Milk	Yes	0.00	2.7	5.4	2.6	0.105
	No	100	97.3	94.6	97.4	

[a,b,c] Values with different superscript letter among agro ecology in the same row differ significantly ($p<0.05$). The p-value in the table represents the significance level to the total one.

Livestock holding

The study district's farming system is characterized by a mixed crop-livestock production system, with relatively similar features across the area. The average livestock size per household was (11.75 ± 0.38) (Table 3). The proportion of livestock in the district was as follows: cattle (49.8%), sheep (32.3%), goats (4.85%), and equines (13.1%). These results indicate that cattle were the predominant livestock species raised in the area. This finding aligns with Gizachew (2002) in Banja districts, but contradicts with the study of Asmare and Yayeh (2017) who reported that horses are the dominant livestock species in Ankesha Guagusa, Ethiopia. The variation may be attributed to differences in the agroecologies of the study areas.

Among equine species, the average number of horses, donkeys, and mules per household in the study area was 2.15±0.17, 2.11±0.07, and 1.13±0.09, respectively. This finding is in line with the reports of Donkey Sanctuary Ethiopia (2011) which is one donkey for every two households in the community. In the highland agroecology, producers owned more horses than donkeys. In contrast, in the midland and lowland agroecology, producers owned more donkeys (Table 3). This might be due to the poor survival of horses and mules in the harsh environment but donkeys can do.

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Table 3. Number of equines and livestock per household

Parameter	Mean ± SE			
	Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)
Livestock	11.53±.699	11.01±.766	12.72±.458	11.75 ±.381
Horse	2.27±.204	1.65±.191	0	2.15±.170
Donkey	1.22± .126[c]	2.22±.110[ab]	2.45±.095[a]	2.11±.068
Mule	1.18±.122	1.0±.00	0	1.13±.091

[a,b,c]Values with different superscript letter in the same row differ significantly ($p < 0.05$); SE = Standard Error.

Feed Resources and supplementation

In the Gozamin district, feed resource availability for equines varies seasonally in quantity and type. The primary feed resources are natural pastures and crop residues, with natural pastures comprising the largest share. Significant differences ($p < 0.05$) exist between highland and other agroecologies, where highlands primarily utilize grazing land and crop residues, while midland and lowland areas rely more on natural pasture (Table 4).

Most respondents use free grazing systems on communal and private lands, which often lack sufficient nutritional value. This reliance on free grazing, combined with limited access to supplementary feeds, leads to frequent nutritional deficiencies among equines, especially during the dry season. Consequently, these factors contribute to low equine productivity in the study area. Inadequate feeding practices result in stunted growth, increased disease susceptibility, reduced work performance, and impaired reproductive capabilities. Improving equine management, particularly through enhanced feeding strategies, is essential for maximizing productivity.

Table 4. Feed sources of equine in the study district

Parameter (%)		Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)	*p*-value
FSDS	GL and CR	94.0[a]	30.1[b]	36.5[b]	53.9	0.000
	GL only	6.0[b]	69.9[a]	63.5[a]	4 6.1	
FSWS	GL	98.8	96.1	95.9	96.93	0.153
	GL and CR	1.2	3.9	4.1	3.07	.
Supplementary feed	Yes	22.9	20.5	28.4	23.9	0.519
	No	74.7	54.8	60.8	63.9	

[a,b,c]Values with different superscript letter among agroecologies in the same row differ significantly ($p<0.05$); The *p*-value in the table represents the significance level to the total one; FSDS=Feed Source at Dry Season, FSWS=Feed Source at Wet Season, GL=Grazing Land, CR=Crop Residue.

Underground water was the major source of water for equines in the lowland (83.8%), while in the highland (95.2%) and midland (82.2%) surface water was the major source. Water source, watering frequency, and distance of watering points were significantly different ($p<0.05$) among agroecologies (Table 5).

Table 5. Watering frequency and distance of water source in the study area

Parameter (%)		Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)	*p*-value
Water source	Surface water	95.2[a]	82.2[b]	16.2[c]	65.7	0.000
	Underground water	4.8[c]	17.8[b]	83.8[a]	34.3	
Watering frequency / day	Freely Available	77.1[a]	61.6[b]	18.9[c]	53.5	0.000
	Once/day	0.0[b]	6.8[a]	9.5[a]	5.2	
	Twice/day	20.5[b]	28.8[b]	70.3[a]	39.1	
	Three/day	2.4	2.7	1.4	2.2	
Water source distance	Mean± SE (meter)	1042±116 [a]	266±376[b]	56±122[c]	478±848	-

[a,b,c]Values with different superscript letter among agro ecology in the same row differ significantly ($p<0.05$); The *p*-value in the table represents the significance level to the total one.

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The watering frequency of equines in the lowland area was twice a day while in the midland and highland, water for equines was freely available. In this study, 53.5% of equines had free access to water. The average distance of the water source was 478±848 meters since the major source was underground water (Table 5).

Housing

Most respondents resided in a highland area where barns are often integrated with family houses. The floors of these barns were typically fully paved with stone, lacking drainage systems and often exhibiting poor cleanliness. The majority of equine owners (68.7%) used separate barn shelters. This finding is contradicted with previous finding in different localities of Ethiopia (Asmare and Yayeh, 2017). Notably, all respondents (100%) reported not providing any special care to their pregnant mares (Table 6). These findings align with Abate (2017), who identified significant management challenges for equines under traditional husbandry systems.

The study revealed significant variations ($p<0.05$) across different agro-ecologies regarding equine housing and the frequency of barn cleaning per week. In this study, equine houses were cleaned four times (50.6%), twice (54.8%), and once (56.8%) per week in highland, midland, and lowland agroecologies, respectively (Table 6).

Table 6. Housing and frequency of cleaning of barn in the study district

Parameter (%)		Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)	*p*-value
Housing type	Separate barn shelter	32.5^{c}	100.0^{a}	78.4^{b}	68.7	0.000
	Stable	0.0^{b}	0.0^{b}	21.6^{a}	7.0	
	With family house	67.5^{a}	0.0^{b}	0.0^{b}	24.3	
Barn cleaning per week	Once/week	0.0^{c}	8.2^{b}	56.8^{a}	20.9	0.000
	Twice/week	12.0^{c}	54.8^{a}	27.0^{b}	30.4	
	Three times/week	37.3 ^{a}	34.2^{a}	0.0^{b}	24.3	
	Four times/week	50.6^{a}	2.7^{b}	0.0^{b}	19.1	
	No cleaning	0.0 ^{b}	0.0 ^{b}	16.2^{a}	5.2	
Housing for Pregnant and Foul	Yes	0.0	0.0	0.0	0.0	
	No	100	100	100	100	

^{a,b,c}Values with different superscript letter among agroecologies in the same row differ significantly ($p < 0.05$); The *p*-value in the table represents the significance level to the total one.

Harnessing

The use of harnesses was slightly higher in highland agroecology compared to other agroecologies. In the midland agroecology, 6.8% of owners did not use harnesses, since the distance from the packing to the homestead was shorter and few respondents believed that using harnesses causes disease (Table 7). The use of harnesses (97.4%) in this study is higher than that reported by Fikru et al. (2015), who found that traditional harnesses and saddles were used by 64% of owners. During field observations, farmers' utilized different harnessing systems, including collar harnesses, breast band harnesses, and local neck yokes. These harnesses were designed to efficiently utilize equine strength, enhancing their performance in terms of speed, energy, and power output during work. This study aligns with Abdela et al. (2017), who reported that collars were padded closely around the equine neck and pointed at the top to prevent wounds.

Table 7. Harnessing and its sources in study area

Parameter (%)		Highland (N=83)	Midland (N=74)	Lowland (N=73)	Total mean (N=230)	*p*-value
Use of harness	Yes	100.0^{a}	93.2^{b}	98.6^{a}	97.4	0.020
	No	0.0^{b}	6.8^{a}	1.4^{b}	2.6	
Type of harness used	Cloth	25.3^{b}	50.7^{a}	46.6^{a}	40.2	0.000
	Sack with straw	6.0^{a}	11.0^{a}	4.1^{a}	7.0	
	Skin	68.7^{a}	31.5^{b}	46.6^{b}	49.8	
	No padding	0.0^{b}	6.8^{a}	2.7^{a,b}	3.1	
Source of harness	From home	90.4	97.3	94.6	93.9	0.190
	Purchasing	9.6	2.7	5.4	6.1	

^{a,b,c}values with different superscript letter among agro ecology in the same row differ significantly ($p < 0.05$).The *p*-value in the table represents the significance level to the total one.

About 93.9% of respondents used harnesses acquired from home. According to the study, harnesses were primarily made from locally available materials, such as leather (49%) and clothing materials (40.2%) (Table 7).

Disease and veterinary service

This study indicated that equines suffer from physical injuries and microbial infection. According to the key informants; anthrax (1st), African horse sickness (2nd), strangles (3rd), pneumonia (4th),

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wound (5^{th}) and digestion colic (6^{th}) were the most prevalent diseases in the areas. In the study area, majority of respondents, specifically 80.4%, indicated that they actively treat their equines, demonstrating high levels of treatment practices. This figure increases to 94.5% in midland agroecology, reflecting a strong commitment among equine owners to the health and well-being of their animals. Conversely, 19.6% of respondents did not treat their equines. This finding contrasts with the results of Fikru et al. (2015), who reported that 79.4% of owners did not provide treatment. The variation in treatment practices could be attributed to factors such as increased awareness of animal welfare, improved access to veterinary clinics, and the availability of traditional medicine. The majority of equine owners sought treatment at government veterinary clinics, while 19.6% relied on traditional medicine (Table 8).

Table 8. Effect of disease and veterinary service

Parameter (%)		Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total mean (N = 230)	*p*-value
Treat ill or Injure	Yes	77.1[b]	94.5[a]	70.3[b]	80.4	.001
	No	29.9[a]	5.5[b]	22.7[a]	19.6	
Veterinary service	Governmentclinic	74.7[a]	76.7[a]	70.3[a]	73.9	0.001
	Private clinic	2.4[b]	16.4[a]	1.4[b]	6.5	
	Traditionally	22.9[a]	6.8[b]	28.4[a]	19.6	
Result of disease	Increase Disease Rate	12.0[b]	43.8b[a]	56.8[a]	36.5	.000
	Decrease work Efficiency	25.3[a]	37.0[a]	40.5[a]	33.9	
	Loss production	62.7[a]	19.2[b]	2.7[c]	29.6	
Summary of equine disease	High	0.0[c]	6.8[b]	45.9[a]	17.0	.000
	Medium	47.0[b]	83.6[a]	54.1[b]	60.9	
	Low	53.0[a]	9.6[b]	0.0[c]	22.2	

[a,b,c]values with different superscript letter among agro ecology in the same row differ significantly ($p < 0.05$).The p-value in the table represents the significance level to the total one.

The study found that disease had significant consequences across all agroecologies, resulting in an increased death rate (36.5%) and decreased work efficiency (33.9%). The prevalence of disease was higher in lowland and midland areas compared to highland areas (Table 8). The

higher disease rate in lowland areas may be attributed to poor feeding, scarcity of water, inadequate housing, and overall poorer management practices compared to highland areas.

Reproductive performances

The average ages of sexual maturity for horses and donkeys were 2.29 ± 0.052 years and 2.16 ± 0.025 years, respectively. The study revealed significant variations ($p < 0.05$) in the average age of sexual maturity for donkeys across different agroecologies. Notably, donkeys in lowland agroecology reached sexual maturity at a younger age (2.01 ± 0.02 years) than those in other agroecologies (Table 9). This earlier onset of sexual maturity in lowland areas may be attributed to warmer temperatures, which provide a more conducive environment for donkeys. Other factors such as feed and water availability, husbandry practices, agroecology, breed might have contributed to the variations. The finding in the current study aligns with Sari et al. (2023), who reported an average age at first mating ranging from 24 to 36 months, with an average of 30.25 ± 5 months. In contrast, Wassie et al. (2023) reported an average age at first mating of 45.28 ± 2.813 months for donkeys.

The study also identified significant differences ($p < 0.05$) in the average mating interval after delivery among agroecologies. On average, equines entered mating within 34.43 ± 0.53 days after delivery. However, this interval was shorter in highland areas (25.18 ± 0.97 days) compared to lowland and midland areas. This shorter mating interval may be due to better access to feed and water, as well as improved management practices in highland regions. According to respondents and Focus Group Discussions (FGDs), several factors influence the mating interval of equines, including management practices, healthcare, access to feed and water, working hours, and the type of work performed. To evaluate the success of equine reproduction, it is crucial to consider the foaling interval, which can be influenced by factors such as the desire to mate after giving birth, timing of mating, service per conception, and mating accuracy (Sari et al., 2023).

In contrast to the current findings, Sari et al. (2023) reported that the postpartum mating interval for Gayo horses averaged 136.63 ± 7.03 days, with a range of 122 to 150 days. According to Kings and Sheryl (2008), maternal fertility during the 3-6 week period after giving birth remains low, returning to normal after 40-60 days. Breeding horses at 40-60 days post-delivery can lead to a pregnancy rate of up to 80%.

The study found that the average number of foals delivered per lifetime was 8.00 ± 0.11 for donkeys and 8.62 ± 0.22 for horses. The average number of foals delivered per lifetime for

donkeys showed significant variation ($p < 0.05$) across agroecologies, but no significant difference was observed for horses. Donkeys in lowland agroecology had a lower average number of foals delivered per lifetime (6.93 ± 0.16) compared to other agroecologies (Table 9). This could be attributed to poor equine management practices, overloading, and scarcity of feed and water in lowland areas, negatively impacting breeding. Additionally, work-related health problems and diseases in lowland areas contribute to increased death rates, ultimately reducing the age and number of foals delivered by donkeys. These findings align with Mulate and Nazir (2016), who reported that external injuries and welfare problems can negatively affect equine production.

The average life expectancy was 11.55 ± 0.14 years for donkeys, 12.86 ± 0.17 years for horses, and 13.69 ± 0.45 years for mules. Significant differences ($p < 0.05$) in life expectancy were observed only for donkeys among agroecologies (Table 9). The current finding contrast with Guyo et al. (2015), who reported that equines can live up to 30 years in favorable environments. Equines are often engaged in long hours of work and when not working, are left to browse and feed on garbage, further compromising their health. This lack of proper care and veterinary attention significantly contributes to the premature death of working equines (Arega et al., 2023). The impact of disease, shortage of feed and water, and poor management practices in lowland areas, might have been negatively affecting the life expectancy of donkeys. In this result, the average life expectancy of mules were better than others species. The longer average life expectancy of mules compared to other species could be due to mules inheriting desirable traits from their parents.

Table 9. Reproductive performances of equine (Mean ± SE)

Parameter %	Highland (N = 83)	Midland (N = 73)	Lowland (N = 74)	Total Mean (N = 230)
Sexual maturity of horse in year	2.28 ± .053	2.50 ± .289	0	2.29 ± .052
Sexual maturity of donkey in year	2.48 ± .062[a]	2.03 ± .019[b]	2.01 ± .014[c]	2.16 ± .025
Mating Interval After Delivery	25.18 ± .971[b]	39.79 ± .152 [a]	39.53 ± .219[a]	34.43 ± .53
Horse Delivery foul/age	8.72 ±.230	7.20 ± .374	0	8.62 ± .220
Donkey Delivery foul/age	8.45 ± .155[a]	8.67 ± .175[a]	6.93 ± .159[b]	8.00 ± .109
Life Expectancy of Donkey (age)	12.11 ± .143[b]	13.04 ± .179[a]	9.55 ± .148[c]	11.55 ± .143
Life Expectancy of Horse (age)	12.92 ± .200	12.63 ± .315	0	12.86 ± .173
Life Expectancy of Mule (age)	13.67 ± .485	14.00 ± .00	0	13.69 ± .454

[a,b,c]Values with different superscript letter in the same row differ significantly (p<0.05).

The study found that the main breeding season (54.2%) was occurred during autumn. This may be attributed to factors such as a reduction in strenuous work for equines, the availability of ample feed and water, and the species' natural seasonal breeding pattern (Figure 2). This aligns with the findings of Gáspárdy et al. (2023), who noted that equines in temperate regions are short-day breeders, most fertile during fall and winter when decreasing daylight triggers melatonin production, stimulating ovulation. This ensures foals are born during warmer months with abundant food. While photoperiod is the primary driver, nutrition, age, and individual variation also influence reproductive cycles of equines.

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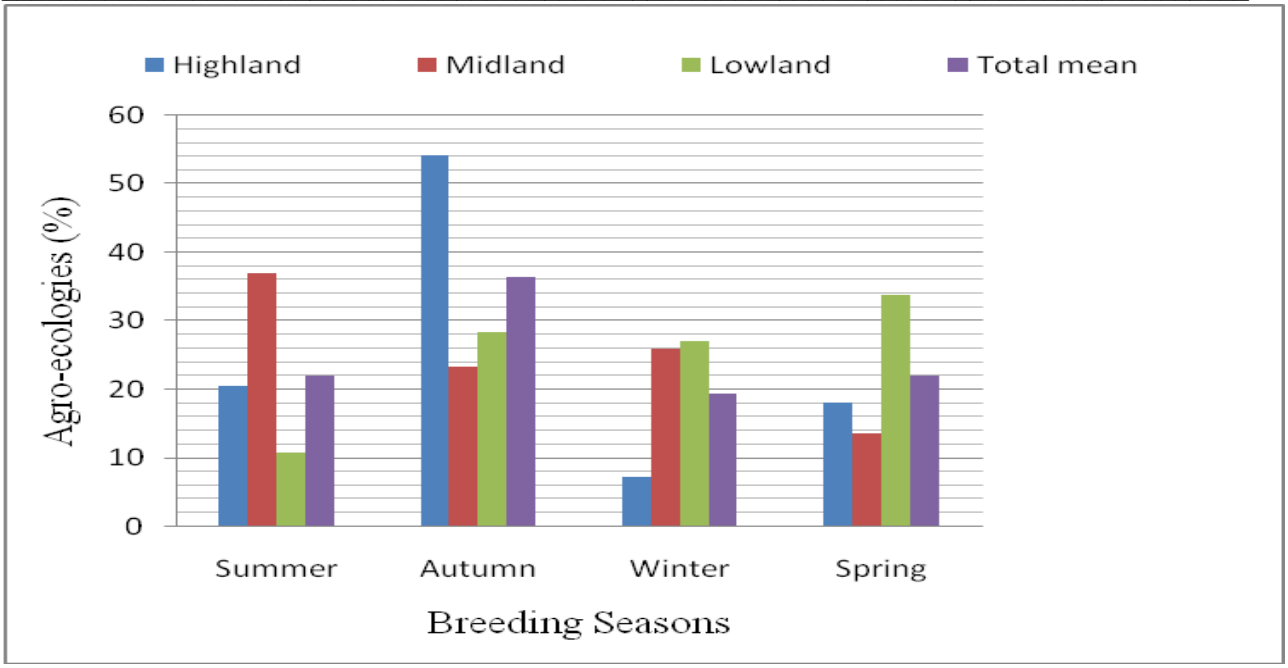

Figure 1. Breeding seasons of equine in the study areas

Equine breeding management, similar to other livestock breeding, can generate significant economic benefits, including increased market value, improved performance, supplementary income, an enhanced genetic pool, high-demand breeds, and contributions to the tourism industry. Therefore, key considerations for equine breeding management should include genetic testing, nutrition and veterinary care, and marketing strategies. Overall, effective breeding management is crucial for maximizing the economic benefits of equine breeding. It requires a combination of knowledge, planning, and investment to produce high-quality horses that meet market demand (Samper, 2009).

Welfare issues

Equines in working areas faced numerous welfare challenges. The study identified several factors contributing to the poor welfare and production of equines, including limited access to forage (47.8%) and water (30.1%), physical health problems (29.7%), and frequent physical contact with saddles (61.6%). Additionally, 69.9% of respondents reported inadequate attention to equine management practices. This study found only significant difference ($p < 0.05$) in the comport/housing of equines across different agroecologies out of various welfare indicators considered (Table 10). Focus group discussions and key informant interviews revealed that common welfare issues includes overloading, poor plowing practices, improper harnessing,

inadequate shelter, and insufficient feeding. The design and fit of harnesses were often inadequate, and saddles were poorly fitted and secured with ropes that caused persistent irritation and injuries.

The current result revealed that the welfare of equines is not protected properly to live in their environment without affecting their health and well-being. This finding is in agreement with the reports of Moltumo et al (2020) in Hosaena and Gelaye and Fesseha (2020) in and around Debre Berhan Town, Central Ethiopia who reported that equines are certainly the most neglected and abused animal. Good welfare will result if the equines are provided with appropriate food, water, shelter, and health care (free from pain, injuries, and diseases), free from discomfort, free from fear and distress, and freedom to express normal behavior. Therefore, the freedoms and welfares of equines should be properly maintained. Thus, more close attention and improvement in the welfare and management of these working animals is mandatory and detailed studies on various aspects of equines are advantageous to fully exploit these animals (Gelaye and Fesseha 2020).

Despite the district's abundant and diverse equine resources, there was a lack of comprehensive extension programs and training on equine production and welfare practices. Equine welfare is largely dependent on the knowledge of owners and communities, and the study found that only 3.9% of respondents had knowledge of equine welfare practices. This lack of knowledge can be attributed to the government's limited attention to training on equine production and welfare issues. This finding aligns with Asebe and Gelayenew (2015), who reported that the overall status of animal welfare in developing countries like Ethiopia is poor. Kumar et al. (2014) also emphasized that equine welfare is a multifaceted concept encompassing good health, comfort, and the ability to express natural behaviors in various regions of the world.

While equines contribute directly and indirectly to household income through production, transportation, and farming, their recognition and social value remain low in the study area. This aligns with Gelaye and Fesseha (2020), who noted that equines are used in socio-economic and ceremonial activities, such as weddings and funerals, yet their value is insufficiently acknowledged.

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Table 10. Welfare issue of equine in the study area

Parameter (%)		Highland (N = 83)	Midland (N = 74)	Lowland (N = 73)	Total mean	*p*-value
Training about equine	Yes	-	-	-	-	-
	No	100.0	100.0	100.0	100.	
Knowing of equine welfare	Yes	7.2	1.4	2.7	3.9	0.137
	No	100.0	100.0	85.5	94.8	
Regular physical contact	Yes	67.5	60.3	56.2	61.6	0.337
	No	32.5	39.7	43.8	38.4	
Restrict access to water	Yes	75.9	71.2	61.6	69.9	0.286
	No	24.1	28.8	38.4	30.1	
Limit access to forage	Yes	62.7	45.2	47.3	52.2	0.056
	No	37.3	54.8	52.7	47.8	
Inhumane use/ physical health	Yes	69.9	74.7	65.8	70.3	0.337
	No	25.3	30.1	34.2	29.7	
Comfortable housing	Yes	94.5^{a}	77.1^{b}	58.3^{c}	74.3	0.001
	No	5.5^{c}	29.9^{b}	41.7^{a}	25.7	
Social value of Equines	High	0.0	1.4	2.4	1.3	0.299
	Medium	14.9	21.9	21.7	19.6	
	Low	75.7	61.6	69.9	69.1	
	Very Low	9.5	15.1	6.0	10.0	

[a,b,c]Values with different superscript letter in the same row differ significantly (p<0.05). The *p*-value listed in the table represents the significance level to the total one.

Major constraints of equine production

Among the constraints, disease prevalence ranked highest, followed by feed shortages and poor management practices, with varying levels of severity across different agroecologies (Table 11). The issues of disease and illness in equines may stem from a lack of awareness regarding healthcare management and inadequate nutrition. These findings are consistent with Mulate and Nazir (2016), who reported that external injuries and welfare problems significantly impact equine production. Similarly, Asmare and Yayeh (2017) identified feed shortages during the dry

season and disease as major constraints for horse production. In Ethiopia, the expansion of crop farming into grazing areas poses a significant challenge for horse grazing, as noted for other livestock species (Fetsum et al., 2009). The constraints identified in this study highlight the need for further research and intervention in equine management within the study district to better leverage the potential of equines for the livelihoods of poor farmers in the area.

Table 21. Constraints of equine production (Ranking)

Agro ecology		1st	2nd	3rd	4th	5th	F sum	Index
Highland	Diseases	53.0	26.5	16.9	3.6	0	428.9	0.28
	Shortage of feed	21.7	25.3	39.8	13.3	0	355.7	0.23
	Shortage of water	8.4	19.3	19.3	28.9	24.1	259	0.17
	Improper harness	3.6	8.4	20.5	20.5	57.8	211.9	0.14
	Management activity	14.5	18.1	15.7	33.7	29.1	288.5	0.19
Midland	Diseases	50.7	32.9	11	4.1	1.4	427.7	0.27
	Shortage of feed	20.5	37	28.2	13.7	0	362.5	0.23
	Shortage of water	1.4	2.7	15.1	32.9	47.9	178.8	0.11
	Improper harness	1.4	11	35.6	35.6	42.5	271.5	0.17
	Management activity	26	17.8	37	13.7	5.5	345.1	0.22
Lowland	Diseases	89.7	9.5	1.4	0	0	490.7	0.31
	Shortage of feed	10.8	59.7	16.2	6.8	6.8	361.4	0.23
	Shortage of water	0	25.7	32.4	25.7	16.2	267.6	0.17
	Improper harness	0	10.8	29.7	29.7	59.3	251	0.16
	Management activity	0	5.4	37.8	39.2	17.6	231	0.14
Total	Diseases	193.4	73	64.9	7.7	1.4	1478.2	0.3
	Shortage of feed	32.5	122	94.2	33.8	64.1	1064.8	0.22
	Shortage of water	9.8	47.7	66.8	87.5	88.2	702.8	0.14
	Improper harness	5	30.2	85.8	88.5	159.6	739.8	0.15
	Management activity	40.5	41.3	90.5	86.6	52.2	864.6	0.18

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Conclusion

Equines play a vital role in economic development worldwide. This study highlights their crucial contributions in the area, where they are utilized for various purposes, including plowing, packing, riding, carting, threshing, and transportation. Despite these diverse roles, equines in this district face significant challenges, including diseases, feed and water shortages, inadequate housing, poor management practices, and improper harness use. These issues negatively impact production, productivity, and work performance of equines. Furthermore, owners often neglect equine reproduction. Therefore, the following isssues need to be addressed: the issue of overworked equines by ensuring adequate nutrition and supplementary feed; developing effective veterinary health care and disease prevention strategies; creating awareness and provide training for equine owners on equine-related technologies, basic management, health care, and welfare issues and enhancing management practices, including housing, health care, and the use of appropriate harnessing materials.

Conflict of interest

All authors declare that there is no any financial and personal conflict of interest**.**

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