**Assessment of Camel Production and Husbandry Practices in Degahbour District, Jarar Zone, Somali Regional State, Ethiopia**

# ABSTRACT

The study was conducted in Degahbur district of the Somali Regional State to generate baseline information on camel production and husbandry practices. Data were collected from four purposively selected kebeles based on camel population and production potential. Using semi-structured questionnaires, focus group discussions, and field observations, 200 households (120 pastoral and 80 agropastoral) were interviewed. Results indicated that the majority of respondents were male (85%) and middle-aged (58%), with a high illiteracy rate (73%), significantly higher among pastoralists (p = 0.002). Pastoralists owned larger camel herds (6.12 ± 0.78) compared to agropastoralists (p < 0.001). Men predominantly performed activities such as feeding (80%), herding (90%), milking (95%), and treating camels (95%), while women were primarily responsible for selling camel milk (85%) and barn cleaning (85%). The main purposes of camel keeping were milk production and income generation. Browsing trees and shrubs were the primary feed resource during the dry season (64%), and wells served as the main water source (62%). Major constraints identified were feed shortages, recurrent drought, and animal diseases. Key opportunities included increasing demand for camel products, multipurpose use of camels, their high adaptability, and cultural significance. Camel production remains vital for local livelihoods but faces significant challenges, particularly in feed and water availability, warranting strategic interventions. Strengthening integrated support systems including improved feed and water management, veterinary services, and market access is essential to enhance camel production and pastoral and agropastoral livelihoods in the area.

**Key words**: Camel Production, Husbandry practices, Pastoralists, Agro-pastoralists

**INTRODUCTION**

Camel (*Camelus dromedaries*), the most climate resilient livestock, plays a significant role in the livelihood of pastoral and agro-pastoral communities in Ethiopia (Mirkena *et al.,* 2018). The current world camel population number estimated to be 35 million heads (FAO, 2019), most of which are in Somalia, Niger, Kenya, Chad, Ethiopia, Mali, Mauritania and Pakistan. Five bordering countries - Somalia, Ethiopia, Kenya, Sudan, and Djibouti hold 84% of African and more than half of the world's camel population (Kena, 2022). Areas of camel rearing are expanding partly due to changes in climate especially in Africa (Faye, 2015). Camels (*Camelus dromedaries*) are very important domestic animal species uniquely adapted to arid and semiarid zones in Asia and Africa (Faraz *et al.,* 2021).

In Ethiopia, 8.1 million heads of dromedary camels are reared in arid and semi-arid regions (CSA, 2021) and the majority of these camels are found in eastern part of the country. Many camel rearing communities in diverse eco-zones in various part of the globe are dependent on camels for their livelihood (Yosef *et al.,* 2014; Faraz *et al.,* 2021). The various camel populations that found in Ethiopia have different trait of interests for which they are chosen by the pastoralists keeping them. They contribute to household food security through meat and milk (Yosef *et al.,* 2014; Faraz *et al.,* 2021), are used as pack animals for transport, hides and wool are products that emanate from camels (Faraz *et al.,* 2021). Sisay *et al.* (2015) Camel milk has a great economic role to pastoralists’ livelihoods as well as those engaged in marketing of camel milk and its products in Ethiopia. Camels are the major livelihood alternative in the arid and semi-arid areas since other animals’ species are less adapted to the harsh and dry climate (Aklilu *et al.,* 2019; Faraz *et al.,* 2021).

Management practice in Ethiopia is basically traditional and the pastoralist under this management only practiced extensive range camel production system and there is no improved forage production for meat, milk and draft purpose (Eyasu, 2009; Yosef *et al.,* 2014; Yohannes *et al.,* 2015).

The camel's major role to food security in semi dry and dry zones and its being main part of the agro-pastoral systems in vast pastoral areas in Africa and Asia, but little is known about its production potential and production systems compared to other domestic animals. The production potential of the camel has received lamentably little attention and underestimated due to different reason (Mehari *et al.,* 2007; Simenew *et al.,* 2013). The main one includes meat and milk is yet mainly intended for substance farming and availability of less attention by researchers and accessibility of few references. These indicate that there are no specific support efforts aimed at increasing camel production through modern husbandry and health care activities due to poor overall management, widely spread diseases and lower attention to camel research where these constraints and their impacts are not identified to the specific study area. Therefore, the objective of this study was to assess the potential of camel production and husbandry practices in Degahbur district, Somali regional state, Ethiopia.

# MATERIALS AND METHODS

## Description of the Study Area

The study was conducted in Degahbur district of Jarar zone, Somali regional state, Ethiopia. The district is located at 8o13’ North of longitude and 43o34’ East latitude at the distance of about 160 km south of Jigjiga town. The altitude of the district is 1044 meters above sea level. It has mean annual minimum and maximum temperatures of 11 and 33oC, respectively. The mean annual rainfall and humidity of the area ranges from 300 to 400 mm and 31 to 36%, respectively. However, the rainfall pattern is erratic and has uneven distribution. There are two prevailing agricultural production systems in the district namely pastoral and agro-pastoral production systems. However, the most prevailing farming system is pastoralism whereby people mainly keep livestock, particularly camels, goats, sheep, and cattle; and to some extent crop (like sorghum and maize) production is also practiced in the district.



Figure 1: Map of the study area

##

## Study Design and Sampling Technique

A cross-sectional study was conducted in Degahbur district to collect relevant data on camel production, husbandry practices, and major constraints to camel production. A purposive sampling technique was used to select four kebeles—two representing the pastoral production system and two representing the agropastoral production system—out of a total of twenty kebeles in the district. The selection was carried out in consultation with experts from the pastoral development offices of Degahbur district, with the aim of incorporating pastoralists’ indigenous knowledge on camel production and husbandry practices for the selection of households.

The criteria for household selection included camel ownership and herd size. A total of 200 households were purposively selected and interviewed: 120 from the pastoral and 80 from the agropastoral production system. Since the pastoral production system was dominant in the district, a larger number of households were selected from this system compared to the agropastoral one.

## Data Collection Methods

Data were collected using a semi-structured questionnaire, focus group discussions, key informant interviews, and field observations. The questionnaire focused on the socioeconomic characteristics of the households, livestock composition, purposes of keeping camels, camel husbandry practices such as feeding, housing, water sources and related problems, major camel diseases, constraints, and opportunities for camel production.

Additionally, one focus group discussion was held at each study site, consisting of 8–12 members. Furthermore, office heads and experts from the district pastoral development office, development agents, elders, community leaders, and individuals with extensive experience in camel rearing were interviewed as key informants.

Field observations were also conducted by the researchers to directly observe and validate the actual husbandry practices, assess the physical environment, identify existing constraints, and cross-check the reliability of the information gathered through interviews and discussions. These observations provided context-specific insights and helped enhance the accuracy and completeness of the data collected.

**Data Analysis**

The collected data were organized, summarized, and analyzed using the Statistical Package for Social Sciences (SPSS), version 26.0. The qualitative data were analyzed using descriptive statistics such as mean, standard deviation (SD), percentage, and frequency. Indices were calculated to analyze the rankings of the purposes of keeping camels, trait preferences, selection criteria, and constraints of camel production.

The ranking was expressed using the following index formula:

**Index** = Σ (4 × Rank 1 + 3 × Rank 2 + 2 × Rank 3 + 1 × Rank 4) for an individual reason ÷ Σ (4 × Rank 1 + 3 × Rank 2 + 2 × Rank 3 + 1 × Rank 4) for all reasons (Kosgey, 2004).

**RESULTS AND DISCUSSION**

## Demographic Characteristics of the Camel Producers

Table 1 presented the socio-economic profile of camel producers in the study area. The study indicates a predominance of male respondents (85.0%) in camel production, with 86.7% in pastoral and 82.5% in agro-pastoral households. This aligns with findings from studies in the Somali Region, where men are primarily responsible for camel husbandry activities. For instance, a study by Tadesse et al. (2014) highlighted that in Somali pastoral communities, men are predominantly involved in camel management, including breeding, health care, and marketing.

The age distribution shows that 58.0% of respondents are between 31 and 60 years old. This is consistent with findings from a study in the Somali Region by Keskes et al. (2013), which reported that the majority of camel producers are middle-aged adults. This age group is often characterized by substantial experience in camel management, which is crucial for adapting to environmental challenges and implementing sustainable practices.

The study reveals a high illiteracy rate among respondents, with 73.0% overall, particularly in the pastoral group (81.7%). This is consistent with findings from a study in the Somali Region by Tadesse et al. (2014), which reported low literacy levels among camel herders. Limited formal education can hinder the adoption of improved camel husbandry practices and access to veterinary services, underscoring the need for targeted educational interventions. The higher percentage of illiteracy is similar with the findings of Hassen *et al.* (2022) who reported a higher illiteracy for Degahur district, Somali regional state, Ethiopia. The role of education is obvious in affecting household income, adopting technologies, demography, health, and as a whole the socio-economic status of the family as well (Kerealem, 2005). This demonstrates the need of providing training and extension services to the local community.

The majority of households reported having between 6–10 members (53.0% overall), which aligns with the communal nature of pastoralism. Larger family sizes can provide more labor for camel management but also place higher demands on resources. A study by Tadesse *et al.* (2014) noted that family size influences labor availability for camel herding and other pastoral activities.

The overwhelming majority of respondents were married (94.0% overall), reflecting the importance of family structures in pastoral societies. Marriage is often associated with social cohesion and the transfer of knowledge across generations in camel management. This is supported by findings from Tadesse *et al.* (2014), which emphasized the role of family units in sustaining camel production systems.

The demographic characteristics observed in this study are consistent with those reported in other research within the Somali Region. For example, a study by Keskes *et al.* (2013) on camel production systems in the Somali Regional State found similar trends in sex distribution, age, and educational levels among camel producers. Additionally, challenges such as diseases, feed shortages, and lack of veterinary services were identified as major constraints in camel production, aligning with the findings of this study.

Table 1. Socio-economic profile of the camel producers in the study area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Pastoral (n=120)** | **Agro-pastoral (n=80)** | **Overall (n=200)** | **χ²** | ***P*** |
| **N** | **%** | **N** | **%** | **N** | **%** |  |  |
| **Sex** |  |  |  |  |  |  | 0.68 | 0.409 |
| Male | 104 | 86.7% | 66 | 82.5% | 170 | 85.0% |  |  |
| Female | 16 | 13.3% | 14 | 17.5% | 30 | 15.0% |  |  |
| **Age (years)** |  |  |  |  |  |  | 1.69 | 0.429 |
| <30 | 34 | 28.3% | 29 | 36.3% | 63 | 31.5% |  |  |
| 31–60 | 74 | 61.7% | 42 | 52.5% | 116 | 58.0% |  |  |
| >60 | 12 | 10.0% | 9 | 11.3% | 21 | 10.5% |  |  |
| **Educational level** |  |  |  |  |  |  | 12.39 | 0.002 |
| Illiterate | 98 | 81.7% | 48 | 60.0% | 146 | 73.0% |  |  |
| Read and write | 19 | 15.8% | 23 | 28.8% | 42 | 21.0% |  |  |
| Primary school | 3 | 2.5% | 9 | 11.3% | 12 | 6.0% |  |  |
| **Family size** |  |  |  |  |  |  | 7.12 | 0.028\* |
| 1–5 members | 30 | 25.0% | 32 | 40.0% | 62 | 31.0% |  |  |
| 6–10 members | 70 | 58.3% | 36 | 45.0% | 106 | 53.0% |  |  |
| >10 members | 20 | 16.7% | 12 | 15.0% | 32 | 16.0% |  |  |
| **Marital status** |  |  |  |  |  |  | 5.72 | 0.057 |
| Single | 2 | 1.7% | 4 | 5.0% | 6 | 3.0% |  |  |
| Married | 116 | 96.7% | 72 | 90.0% | 188 | 94.0% |  |  |
| Divorced/Widowed | 2 | 1.7% | 4 | 5.0% | 6 | 3.0% |  |  |

**Livestock Holding**

The livestock holdings data from the study area indicate significant differences between pastoral and agro-pastoral households across all major livestock species (p < 0.001). The mean herd sizes for camels, goats, sheep, cattle, and donkeys differ notably.

Pastoral households hold a larger mean number of camels (6.12 ± 0.78) compared to agro-pastoralists (5.20 ± 0.61). Camels are central to pastoral livelihoods in arid and semi-arid Somali regions due to their resilience to harsh climatic conditions, drought tolerance, and multipurpose utility (milk, meat, transport). This finding aligns with studies by Kena *et al.* (2022) and Gutu et al. (2019), which reported that camels constitute the backbone of pastoral households in Somali region, often representing the primary asset for wealth and risk buffering. The slightly lower number in agro-pastoral systems might be due to increased crop farming, which limits land available for camels and prioritizes other livestock like cattle.

Goat and sheep numbers are higher in pastoral households (49.41 ± 12.00 and 35.47 ± 2.20 respectively) compared to agro-pastoralists (38.50 ± 9.80 and 30.50 ± 2.15 respectively). Small ruminants are favored by pastoralists for their adaptability to rangeland conditions, rapid reproduction, and multiple economic uses such as meat, milk, and income generation. The results corroborate findings by Mahamed and Ali (2023) and Mohammed et al. (2018) who documented that pastoralists in Somali region maintain large goat and sheep herds as part of diversified livelihood portfolios. Agro-pastoralists, by contrast, often integrate crop-livestock systems where small ruminants complement crop residues and provide manure.

Contrary to other species, cattle numbers are significantly higher in agro-pastoral households (5.42 ± 0.57) than in pastoral ones (2.24 ± 0.26). This pattern reflects the agro-pastoralists' dependence on crop farming, which provides fodder and water resources conducive to cattle rearing. Cattle are less drought tolerant but valuable for draft power and milk production in mixed farming systems. This is consistent with the work of Gebremedhin et al. (2016) and Mekonnen and Zeleke (2020), highlighting that agro-pastoralists in Somali region tend to have better access to water and pasture near crop farms, supporting higher cattle populations.

Donkeys are more abundant among agro-pastoralists (1.15 ± 0.21) than pastoralists (0.69 ± 0.17), likely due to their essential role in crop farming communities for transportation of water, firewood, and farm inputs. This supports findings by Said et al. (2019) that describe donkeys as critical for agro-pastoral livelihoods in the Somali region, facilitating household labor and market access.

**Table 2**. Livestock holdings (Mean ± SD) per household in the study area

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Livestock species** | **Pastoral** | **Agro-pastoral** | **Overall** | **p-value** |
| Camel | 6.12 ± 0.78 | 5.20 ± 0.61 | 5.66 ± 0.70 | < 0.001 |
| Goat | 49.41 ± 12.00 | 38.50 ± 9.80 | 43.96 ± 11.03 | < 0.001 |
| Sheep | 35.47 ± 2.20 | 30.50 ± 2.15 | 32.99 ± 2.17 | < 0.001 |
| Cattle | 2.24 ± 0.26 | 5.42 ± 0.57 | 3.83 ± 0.44 | < 0.001 |
| Donkey | 0.69 ± 0.17 | 1.15 ± 0.21 | 0.92 ± 0.19 | < 0.001 |

## Camel Husbandry Practices

### Labor division in camel husbandry

The results presented in Table 3 reveal distinct patterns in the division of labor across camel husbandry tasks among pastoral and agro-pastoral households in the study area. Feeding of camels is predominantly performed by husbands in both systems (80.0% in pastoral, 70.0% in agro-pastoral), though wives and children also participate to varying degrees. Similarly, herding is largely male-dominated, with 90.0% of pastoral and 85.0% of agro-pastoral households reporting husband involvement. These findings align with Farah *et al.* (2004) and [Kaufmann & Blench (2004)], who observed that men traditionally take primary responsibility for feeding and herding camels in pastoral Somali societies due to the animals' high value and mobility needs.

Milking is mainly performed by husbands in both livelihood groups (95.0% in pastoral and 90.0% in agro-pastoral), with minimal participation by wives and children. This is consistent with Somali pastoral norms where camel milking is regarded as a male task due to the cultural prestige associated with camels and the technical skill required (Husein et al., 2020).

Wives were primarily responsible for barn cleaning (85.0% in pastoral and 90.0% in agro-pastoral), reflecting gender roles where women manage hygiene-related tasks around the homestead. Watering was carried out exclusively by husbands in both groups, as shown by 100% participation. This is likely due to the physical effort and distance often required to access water points, a pattern also reported by Gemedo-Dalle et al. (2006) and Oba (2014).

Breeding and treating sick camels are overwhelmingly male-dominated, with over 90% of husband involvement in both systems. These tasks require decision-making authority and access to veterinary services or traditional knowledge, typically reserved for adult men in pastoral societies (Bekele & Ayele, 2011).

Selling camel milk is primarily handled by wives (85.0% in pastoral and 90.0% in agro-pastoral), showing women's key role in marketing dairy products. This gendered division supports household income diversification and is consistent with findings by Younas & Yaqoob (2005) and Devereux (2006), who noted that women are central to milk processing and sale in East African pastoral systems.

Table 3. Labor division in camel husbandry among sample households

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Family member** | **Pastoral** | **Agro-pastoral** | **χ²** | **p-value** |
| Feeding | Husband | 96 (80%) | 56 (70%) |  |  |
| Wife | 78 (65%) | 60 (75%) | 1.82 | 0.61 |
| Children | 60 (50%) | 48 (60%) |  |  |
| Herding | Husband | 108 (90%) | 68 (85%) |  |  |
| Wife | 12 (10%) | 4 (5%) | 6.23 | 0.10 |
| Children | 48 (40%) | 40 (50%) |  |  |
| Milking | Husband | 114 (95%) | 72 (90%) |  |  |
| Wife | 6 (5%) | 2 (2.5%) | 3.27 | 0.35 |
| Children | 24 (20%) | 20 (25%) |  |  |
| Barn cleaning | Husband | 6 (5%) | 2 (2.5%) |  |  |
| Wife | 102 (85%) | 72 (90%) | 0.54 | 0.76 |
| Children | 72 (60%) | 52 (65%) |  |  |
| Watering | Husband | 120 (100%) | 80 (100%) |  |  |
|  |  |
| Breeding | Husband | 108 (90%) | 70 (87.5%) |  |  |
| Wife | 6 (5.0%) | 3 (3.75%) | 3.14 | 0.21 |
| Children | 12 (10%) | 10 (12.5%) |  |  |
| Treating sick animals | Husband | 114 (95%) | 72 (90%) |  |  |
| Wife | 6 (5%) | 4 (5%) | 1.73 | 0.63 |
| Children | 12 (10%) | 10 (12.5%) |  |  |
| Selling camel milk | Husband | 12 (10%) | 4 (5.0%) |  |  |
| Wife | 102 (85%) | 72 (90%) | 1.67 | 0.64 |
| Children | 24 (20%) | 14 (17.5%) |  |  |

### Purpose of Keeping Camels

Table 4 illustrates the primary purposes for keeping camels among pastoral and agropastoral communities in the study area, ranked by importance. For both groups, milk production emerges as the most significant reason, with the highest index values (0.350 for pastoralists & 0.385 for agropastoralists), indicating its vital role in daily sustenance and food security. Income generation follows as the second most important purpose, showing its economic value, particularly among agropastoralists (index 0.306). Transportation ranks third, especially among pastoralists (index 0.144), reflecting its utility in mobility across vast rangelands. Meat, social prestige, and savings are lesser but still notable reasons, with relatively lower index values, showing cultural and financial considerations.

Both pastoral (0.350) and agropastoral (0.385) households ranked milk production as the most important purpose for keeping camels. This is consistent with studies conducted in the Somali Region, which found camel milk to be a critical dietary component and source of income for many households, especially during dry seasons (Farah et al., 2004; Simenew et al., 2013). Its nutritional value and year-round availability make camels uniquely valuable among livestock species.

Income was ranked as the second most important purpose, with higher importance among agropastoralists (0.306) than pastoralists (0.247). This suggests that agropastoral households may have more market access or engage more in commercial sale of camel milk and meat, possibly due to their relatively settled lifestyle and better linkages to markets.

Camels are also valued for their utility in transportation, particularly in pastoral areas (0.144), where infrastructure is limited. Their capacity to travel long distances in arid environments remains an essential function, although it ranks lower than milk and income generation.

Meat ranked relatively low among both groups (0.069), possibly due to cultural and economic reasons, camels are rarely slaughtered unless necessary. Social prestige and savings held more importance among pastoralists than agropastoralists. This reflects the role of camels in social and cultural status in traditional pastoral societies (Guliye *et al.,* 2007).

In general, camel husbandry serves multiple roles in the livelihoods of both pastoral and agropastoral households in the area. Milk and income are the dominant purposes across both groups, while secondary roles like transportation, social status, and savings show notable variation based on production systems. These findings can guide livestock development programs and marketing initiatives in the region by focusing on milk value chains and improving income opportunities from camel products.

Table 4. Purposes of keeping camels in the study area

|  |  |  |
| --- | --- | --- |
| **Purpose(s)** | **Pastoral** | **Agropastoral** |
| **R1** | **R2** | **R3** | **Index** | **R1** | **R2** | **R3** | **Index** |
| Milk | 60 | 30 | 12 | 0.350 | 45 | 20 | 10 | 0.385 |
| Income | 30 | 35 | 18 | 0.247 | 25 | 30 | 12 | 0.306 |
| Transportation | 10 | 22 | 30 | 0.144 | 5 | 12 | 20 | 0.123 |
| Meat | 5 | 10 | 15 | 0.069 | 3 | 7 | 10 | 0.069 |
| Social prestige  | 8 | 12 | 20 | 0.094 | 2 | 5 | 12 | 0.058 |
| Savings | 7 | 11 | 25 | 0.094 | 0 | 6 | 16 | 0.058 |

R= rank

**Feeds and Feeding of Camels**

Table 5 presents the major available feed resources for camels during wet and dry seasons in the study area, comparing pastoral and agropastoral systems. During the wet season, browsing trees and shrubs are the dominant feed source for both pastoralists (53.3%) and agropastoralists (46.2%), followed by herbaceous species and grass species, with no statistically significant difference between the two systems (p = 0.233). However, during the dry season, browsing trees and shrubs become even more crucial, especially for pastoralists (73.3%) compared to agropastoralists (50.0%), and this difference is statistically significant (p < 0.001). Additionally, agropastoralists utilize crop residues such as sorghum and maize stover (10.0% and 16.2%, respectively), which are absent in pastoralist feeding practices. Overall, browsing trees and shrubs constitute the most important feed resource year-round, with agropastoralists supplementing camel diets with crop residues during the dry season.

The study revealed that browsing trees, shrubs, and herbaceous species were the common feed resources for camels in the study area. This finding aligns with the report by Mirkena *et al.* (2018), who noted that the major feed resources for camels are browsing trees or bushes, although grasses may be consumed when shrubs or trees are unavailable.

Feed availability is one of the major factors hindering camel production. In the study area, browsing plants such as trees and shrub species were the primary feed resources utilized for camels. Most of the district’s land was covered with woody vegetation, making trees and shrubs important sources of camel feed throughout the year. Browsing was the main form of camel feed utilization. During the wet season, browsing trees and shrubs were the major feed resource, followed by herbaceous species. This agrees with findings from other studies by Tsedeke (2007) and Tesfaye (2008), which indicated that browse forage is the main feed resource for livestock in Ethiopia. Although the availability of crop residues was low, maize and sorghum straws were fed mainly to camels by agropastoralists during the dry season. This is consistent with the study by Abate *et al.* (2012), who reported that maize and sorghum stover are used primarily during the dry season in the southeastern parts of the country.

Table 5. Major avaialable feed resources for camels in the study area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Feed Resource** | **Pastoral** | **Agro-pastoral** | **Overall** | **χ²** | **p-value** |
| **N** | **%** |  | **%** |  | **%** |
| **Wet season** |  |  |  |  |  |  | 2.91 | 0.233 |
| Herbaceous species | 40 | 33.3% | 25 | 31.2% | 65 | 32.5% |  |  |
| Browsing trees & shrubs | 64 | 53.3% | 37 | 46.2% | 101 | 50.5% |  |  |
| Grass species | 16 | 13.3% | 18 | 22.5% | 34 | 17% |  |  |
| **Dry season** |  |  |  |  |  |  | 35.74 | < 0.001 |
| Herbaceous species | 32 | 26.7% | 19 | 23.8% | 51 | 25.5% |  |  |
| Browsing trees & shrubs | 88 | 73.3% | 40 | 50% | 128 | 64% |  |  |
| Sorghum Stover | - | - | 8 | 10% | 8 | 4% |  |  |
| Maize Stover | - | - | 13 | 16.2% | 13 | 6.5% |  |  |

### Water Sources and Related Problems

Table 6 presents the sources of water and related problems faced by pastoral and agropastoral communities in the study area. Wells are the predominant water source overall (62%), with a higher usage among pastoralists (68.8%) compared to agropastoralists (56.3%), and this difference is statistically significant (p = 0.0007). Surface water is used less frequently by both groups (9.5% overall), while ponds are more commonly used by agropastoralists (31.2%) than pastoralists (11.7%). Regarding water-related problems, scarcity is the most commonly reported issue, affecting 65% of respondents with no significant difference between the two groups. Other challenges include water impurity or unhygienic conditions (14%) and long distances to water sources (21%), which are similarly reported among pastoralists and agropastoralists. Overall, wells are the main water source in the area, but water scarcity remains a persistent problem for both communities.

This finding aligns with the typical lifestyle differences between pastoralists and agro-pastoralists in the Somali Region. Pastoralists, who often move seasonally in search of grazing and water, tend to use more permanent water sources such as wells, which provide reliable water access in arid areas. On the other hand, agro-pastoralists, who are more settled and involved in farming, may have better access to surface water bodies like ponds, which can also serve crop irrigation needs alongside livestock watering (Ibrahim & Mohamed, 2019; Yusuf *et al.,* 2018).

Regarding water-related problems, both groups reported water scarcity as the most pressing issue, affecting approximately two-thirds of households (65%). Other problems such as water impurity and long distances to water sources were also noted but were less prominent. The chi-square test shows no significant difference between pastoral and agro-pastoral households regarding these problems (p = 0.81), suggesting that water scarcity and quality issues are common challenges regardless of livelihood type.

Water scarcity is a widely documented constraint in Somali Region’s dryland environments, severely limiting livestock productivity and household welfare (Ahmed *et al.,* 2018). Long distances to water sources increase labor burden, especially for women and children, and can lead to decreased water consumption by animals, impacting their health and productivity (Mohamed *et al.,* 2020). Similarly, the use of unhygienic or contaminated water sources can predispose livestock to diseases, affecting overall herd health.

The study findings emphasize the urgent need for sustainable water management strategies tailored to different livelihood systems. For pastoralists, improving access to reliable wells and boreholes is critical, while agro-pastoralists would benefit from improved pond management and water harvesting techniques. Community-based water resource management and investments in water infrastructure could help alleviate scarcity and improve water quality, thereby supporting livestock production and household resilience in the face of climate variability.

Table 6. Sources of water and related problems in the study area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter** | **Pastoral** | **Agro-pastoral** | **Overall** | **χ²** | **p-value** |
| **N** | **%** | **N** | **%** | **N** | **%** |
| **Water source** |  |  |  |  |  |  |  |  |
| Well | 79 | 68.8 | 45 | 56.3 | 129 | 62 | 14.57 | 0.0007 |
| Surface water | 9 | 7.5 | 10 | 12.5 | 19 | 9.5 |  |  |
| Ponds | 14 | 11.7 | 25 | 31.2 | 39 | 19.5 |  |  |
| **Water related problems** |  |  |  |  |  |  |  |  |
| Scarcity | 80 | 66.7 | 50 | 62.5 | 130 | 65 | 0.43 | 0.81 |
| Unhygienic / impurity | 16 | 13.3 | 12 | 15 | 28 | 14 |  |  |
| Long distance to water source | 24 | 20 | 18 | 22.5 | 42 | 21 |  |  |

### Housing of Camels

Table 7 presents the types of housing used for camels in the study area, highlighting significant differences between pastoral and agropastoral production systems. The majority of pastoralists (75.0%) do not provide permanent housing for camels, while only 25.0% of agropastoralists fall into this category. Conversely, agropastoralists are more likely to use temporary shelters (50.0%) and permanent housing (25.0%) compared to pastoralists (16.7% and 8.3%, respectively). Overall, 55.0% of camel owners do not use permanent housing, 30.0% use temporary shelters, and only 15.0% use permanent housing. The difference in housing practices between the two groups is statistically significant (p < 0.0001), indicating that agropastoralists are more inclined to provide structured housing for camels than pastoralists.

The transition toward more permanent housing structures among agro-pastoralists may also indicate ongoing changes in land use patterns, sedentarization, and adaptation to climate variability. Previous studies in the Somali Region (Farah *et al.,* 2004; Kena *et al.,* 2022) support these findings, noting that improved housing contributes to better health management, productivity, and security of camels. Overall, the results highlight the influence of livelihood strategies and settlement patterns on camel husbandry practices in dryland areas.

**Table 7.** Housing of camels in the study area

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Housing Type** | **Pastoral** | **Agro-pastoral** | **Overall** | **χ²** | **p-value** |
| **N** | **%** | **N** | **%** | **N** | **%** |
| No permanent housing | 90 | 75.0% | 20 | 25.0% | 110 | 55.0% | 42.91 | <0.0001 |
| Temporary shelter | 20 | 16.7% | 40 | 50.0% | 60 | 30.0% |  |  |
| Permanent housing | 10 | 8.3% | 20 | 25.0% | 30 | 15.0% |  |  |

**Constraints of Camel Production**

Table 8 outlines the major constraints affecting camel production in pastoral and agropastoral systems. In both systems, shortage of feed ranks as the most significant constraint, with index values of 0.240 for pastoralists and 0.260 for agropastoralists. Recurrent drought is the second major challenge in both systems (indices: 0.222 & 0.231, respectively), followed by animal diseases (0.172 for pastoralists and 0.160 for agropastoralists). Other constraints, including marketing problems, water scarcity, and inadequate veterinary services, also impact camel production, though to a lesser extent. Issues related to low genetic improvement and value chain inefficiencies were reported less frequently, reflected by their lower index values. Overall, feed shortage, drought, and disease emerge as the top three challenges, with slightly greater emphasis placed on feed and drought by agropastoralists, indicating a shared but nuanced pattern of production constraints across both systems.

For pastoralists, the leading constraint is shortage of feed (Index = 0.240), followed closely by recurrent drought (0.222). This pattern reflects the heavy reliance of pastoral camel production on natural rangelands, which are highly vulnerable to seasonal and prolonged dry spells. Feed scarcity, often exacerbated by drought, directly impacts camel health, milk production, and reproduction. These findings are consistent with studies from the Somali region and similar arid environments (Farah *et al.,* 2007; Abebe *et al.,* 2020), which report feed availability as a critical limiting factor in camel productivity.

Similarly, the agropastoral system reports feed shortage as the foremost challenge (Index = 0.260), slightly higher than pastoralists, possibly due to smaller grazing areas and increasing land competition with crops. Recurrent drought also ranks second (0.231), confirming its disruptive role across both systems. The greater vulnerability of agropastoralists to feed shortages is linked to environmental degradation and changes in land use (Mohammed *et al.,* 2019).

Other constraints such as animal diseases and marketing problems appear significant in both systems but rank slightly higher among pastoralists. Diseases remain a critical issue, often aggravated by poor veterinary infrastructure and lack of timely treatment, which reduce productivity and increase mortality (Ahmed *et al.,* 2018). Marketing challenges, including poor infrastructure, price volatility, and limited access to formal markets, further constrain income generation from camels, especially for pastoralists who rely more on livestock sales.

Constraints like water scarcity, inadequate veterinary service, low genetic improvement, and marketing and value chain issues are comparatively less prominent but remain important barriers that could limit long-term sustainability and growth of camel production. Notably, these issues highlight systemic challenges related to infrastructure, service delivery, and genetic resource management, which have been identified in several regional livestock studies (Teshome *et al.,* 2021; Abebe & Abate, 2019).

In summary, the findings indicate that resource limitations, primarily feed shortage and drought, are the overriding constraints affecting camel production in both pastoral and agropastoral settings. Addressing these through integrated feed management, drought resilience strategies, improved veterinary services, and strengthened market linkages will be essential to enhancing camel productivity and livelihoods in the Somali region.

Table 8. Major constraints of camel production in the study area

|  |  |  |
| --- | --- | --- |
| **Constraint(s)** | **Pastoral** | **Agropastoral** |
| **R1** | **R2** | **R3** | **Index** | **R1** | **R2** | **R3** | **Index** |
| Shortage of feed | 35 | 25 | 18 | 0.240 | 25 | 20 | 10 | 0.260 |
| Recurrent drought | 30 | 24 | 22 | 0.222 | 20 | 18 | 15 | 0.231 |
| Animal diseases | 20 | 22 | 20 | 0.172 | 12 | 14 | 13 | 0.160 |
| Marketing problem | 12 | 18 | 16 | 0.122 | 8 | 10 | 14 | 0.121 |
| Water scarcity | 10 | 12 | 12 | 0.092 | 5 | 6 | 10 | 0.077 |
| Inadequate veterinary service | 6 | 10 | 14 | 0.072 | 4 | 5 | 6 | 0.058 |
| Low genetic improvement | 4 | 6 | 10 | 0.047 | 3 | 4 | 7 | 0.050 |
| Value chain issues | 3 | 3 | 8 | 0.032 | 3 | 3 | 5 | 0.042 |

**Opportunities for Camel Production**

The major opportunities for camel production identified in both pastoral and agropastoral systems include increasing demand for camel products, the multipurpose use of camels, high adaptability of camels, and their cultural importance. In pastoral areas, the highest-ranked opportunity is the increasing demand for camel products (Index = 0.300), followed by multipurpose use (0.255), high adaptability (0.225), and cultural importance (0.220). Similarly, in agropastoral communities, increasing demand for camel products ranks highest (0.312), followed by multipurpose use (0.225), high adaptability (0.212), and cultural importance (0.168). These results suggest a strong recognition among both groups of the economic and cultural potential of camels, with slight variations in priority.

The increasing demand for camel products, such as milk, meat, and hides, represents a significant market opportunity for camel producers, reflecting broader trends in Ethiopia and the Horn of Africa where camel products are gaining value due to their nutritional and economic benefits (Kassahun *et al.,* 2016; Teka *et al.,* 2018). The multipurpose use of camels—ranging from transport and draft power to social status and income generation, reinforces their critical role in sustaining livelihoods, especially in arid and semi-arid regions (Fekadu *et al.,* 2018). High adaptability of camels to harsh environments gives them an advantage over other livestock species in areas affected by climate variability and drought, making them more reliable assets for pastoral and agropastoral households (Gebreyohannes *et al.,* 2016). Lastly, cultural importance plays a key role in maintaining camel husbandry traditions, which helps ensure the continuity of knowledge and practices critical for sustainable camel management (Aklilu *et al.,* 2019). These opportunities align well with national efforts to promote climate-resilient livestock systems and rural development in dryland areas of Ethiopia.

Table 9. Major opportunities of camel production in the study area

|  |  |  |
| --- | --- | --- |
| **Opportunities** | **Pastoral** | **Agropastoral** |
| **R1** | **R2** | **R3** | **Index** | **R1** | **R2** | **R3** | **Index** |
| Increasing demand for camel products | 40 | 30 | 20 | 0.300 | 30 | 20 | 15 | 0.312 |
| Multipurpose use of camels | 35 | 25 | 18 | 0.255 | 20 | 18 | 12 | 0.225 |
| High adaptability of camels | 30 | 20 | 15 | 0.225 | 18 | 15 | 10 | 0.212 |
| Cultural Importance | 15 | 15 | 12 | 0.220 | 12 | 10 | 8 | 0.168 |

**CONCLUSION**

The study reveals that camel production plays a vital socio-economic and cultural role in both pastoral and agropastoral communities of the study area. Camels are primarily kept for milk production and income generation, emphasizing their economic importance. Feed availability is seasonally variable, with browsing trees and shrubs as the major feed resources, particularly during the dry season. Water scarcity and poor water quality remain critical challenges alongside feed shortages, recurrent drought, and animal diseases, all constraining camel productivity. Housing practices vary markedly between systems, with most pastoral camels lacking permanent housing. Nonetheless, opportunities such as increasing demand for camel products, the multipurpose nature of camels, their high adaptability, and cultural significance provide strong potential for enhancing camel production. Addressing the identified constraints through improved feed and water management, veterinary services, and market development will be essential to sustainably develop the camel sector and improve livelihoods in the study area.

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