

Major Constraints of Intensification of Camel Husbandry in Mogadishu, Somalia

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Abstract: Livestock is the backbone of Somalia's economy. It has yet to be fully exploited, particularly camels which are highly adapted to harsh ecosystems, and it is a multipurpose animal mainly used for meat and milk production. Although the intensification of camel production is essential to meet the Sustainable Development Goals (SDG), it is still infancy in Somalia. A cross-sectional study assessed the major constraints of the intensification of camel husbandry in Mogadishu, Somalia. The samples were purposively selected from intensive and semi-intensive camel dairy farms through a semi-structured questionnaire. Thus 67 intensive and semi-intensive camel dairy farms were surveyed in the outskirts of seven districts in Mogadishu. This study revealed that the ecotype of the camel was 47% Hoor, whereas 28% were Eydimoo, 14% were Siifdacar, and 11% were Geelab. Male and female camels' average maturity age was 81.49 and 54.9 months, respectively. Age at first calving was 78.72 months. The calving interval of the dromedary camel and lactation length was 21.76 and 19.28 months, respectively. The study also showed that the average milk production was 4 liters per camel daily. Most farms use the loose house system: 85% use open houses, and 15% use fenced and tree shelter houses. On the herd composition of camel farms visited, 48% were lactating camels, 4% were dry camels, 25% were heifers, and 23% were bulls, respectively. The major constraint faced by farmers were 27% a lack of knowledge, 40% high feed costs, 24% diseases, and 9% a poor market. To our knowledge, this is the first study on the intensification of camel farming in Somalia. We recommend further studies to facilitate the intensification of camel husbandry in Somalia in different regions and seasons.

Keywords: Intensification, Camel, Constraint, Husbandry, Mogadishu

1. Introduction

The intensification of livestock production that began decades ago led to the so-called "green revolution" in crop output and the expansion of livestock production [11]. Intensive and semi-intensive camel farming systems, camel milk, has been produced by hand milking. Locals have traditionally consumed it without additional processing, and only a tiny portion of the product has reached urban markets [17].

In the next 25 years, the number of camels is anticipated to rise to over 60 million, having increased steadily over the past

few decades to reach over 40 million head of Bactrian and dromedary camels [9]. The yearly global production of camel milk has expanded along with the number of camels, from 0.63 million tonnes in 1961 to 3.15 million tonnes in 2020 [7].

Although most camels are raised in pastoral, extensive, or semi-intensive systems in developing nations, carefully planned intensification could aid the species' development and incorporation into the food supply chain [10, 9]. The livelihood of pastoralists and agro-pastoralists that lives in unstable environments depends heavily on camels [23]. Camels are more tolerant than other livestock, perform well

in challenging situations, and use less energy [2]. The Somali camel owners have chosen the best breeding males based on the following criteria: physical strength, appearance, behavior, skin color, height, and ancestors' traits such as milk production, color, and resistance [14]. Dromedaries are said to reproduce less effectively than other domestic species. The camel has a short breeding season, late puberty, and a long gestation period (13 months), which reduces its reproductive effectiveness in rural environments [1].

Systems for raising animals are evolving quickly over the world. The rise in demand for dairy products, meat, and eggs is mainly driving these changes [5, 20]. Within these determinants, tradition, resources, family life cycle, and wealth status are associated with the type of livestock kept by household producers, which differs depending on agro ecological circumstances and the location of the world [4, 15].

2.2. Map of the Study Area

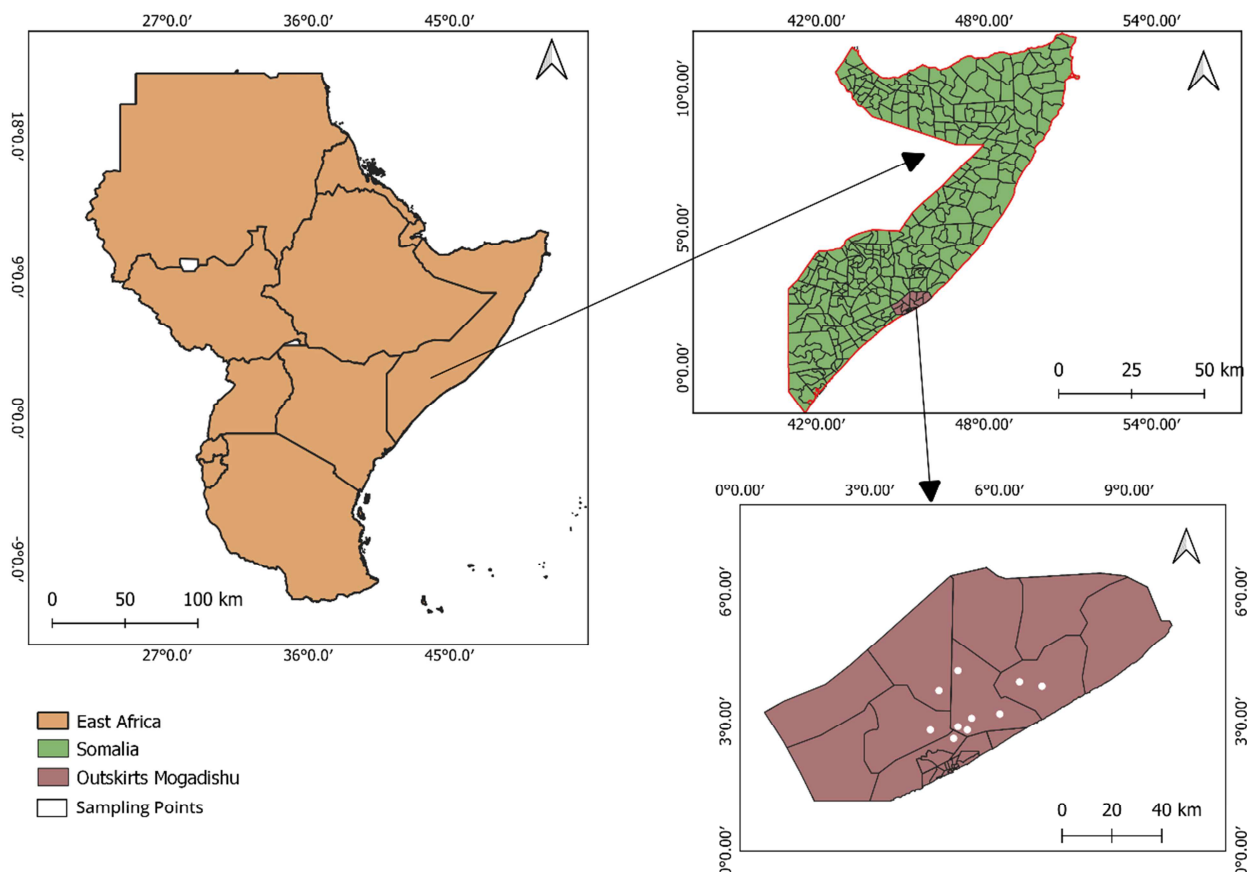


Figure 1. Map of study area.

2.3. Population of the Study

The target population of this study was 80 intensive and semi-intensive camel dairy farms in the outskirts of seven districts of Mogadishu, Somalia.

2.4. Study Design

A cross-sectional study was undertaken on 67 camel dairy

2. Materials and Methods

2.1. Study Area

Mogadishu is Somalia's capital city, consisting of 18 districts. This region is bordered by both Lower and Middle Shebelle region and the Indian Ocean, and its capital is Somalia. The study was conducted in seven districts of Mogadishu, Somalia: Hodan, Garasbaley, Dayniile, Yaqshiid, Karan, Hiliwa, and Kaxda districts.

There needs to be more information on the Mogadishu camel population in particular. Therefore, most of these districts were outskirts of Mogadishu and were selected purposively due to their Animal population. Samples were collected randomly from the semi-intensive and intensive camel dairy farms in Mogadishu, Somalia.

farms and managed intensive and semi-intensive farms in several outskirts of seven districts in Mogadishu. The survey was conducted from June to March 2023.

2.5. Sample Size

The number of camel dairy farms required for the study was determined by using the formula given by Slovene's formula for simple random sampling.

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the required sample size, N is the target population size and e is the standard error or level of significance, which is popularly known to be =0.05 or 5%. For this study, $N = 80$ and so the sample size will be calculated as follows;

$$n = \frac{80}{1 + 80(0.05)^2}$$

$$n = \frac{80}{1.2} = 67$$

The sample consisted of 67 camel dairy farmers. A questionnaire survey was administered to all 67 camel dairy farm employees/owners. The questionnaire was designed to gather information about the study animals, such as ecotype, Housing system, Herd structure, production and reproduction, milking, and feeding management.

2.6. Sampling Procedure

In this study, a purposive sampling technique was used. Mogadishu's seven district outskirts were selected because the most intensive and semi-intensive camel dairy farms are the capital and close to both lower and middle Shabelle regions. These areas heavily practice both intensive and semi-intensive production systems. Camel dairy farms selection was based on a random selection by listing all camel dairy farms in the district's outskirt of Mogadishu.

2.7. Data Collection Instrument

The study used a questionnaire survey among camel dairy farmers to assess the knowledge and practice among these farmers towards the process of intensification of camel husbandry.

The questionnaire was administered to all camel dairy farmers whose farms were located in the study area. The information gathered relates to their knowledge and practices of ecotype, housing system, milking, production and reproduction parameters, type of management, breeding, and feeding management.

2.8. Data Analysis Procedure

The data collected and recorded on specifically designed forms and prepared for analysis was entered in the Microsoft Excel spreadsheet and analyzed with SPSS version 26 statistical software.

3. Results

3.1. Camel Eco-type Present in the Farm

The figure 2 below illustrates the ecotype of camels that were present in the farms and that they make up the majority of the camels raised 47% were Hoor, compared to 28% were Eydimio, 14% were Siifdacar, and 11% were Geelab.

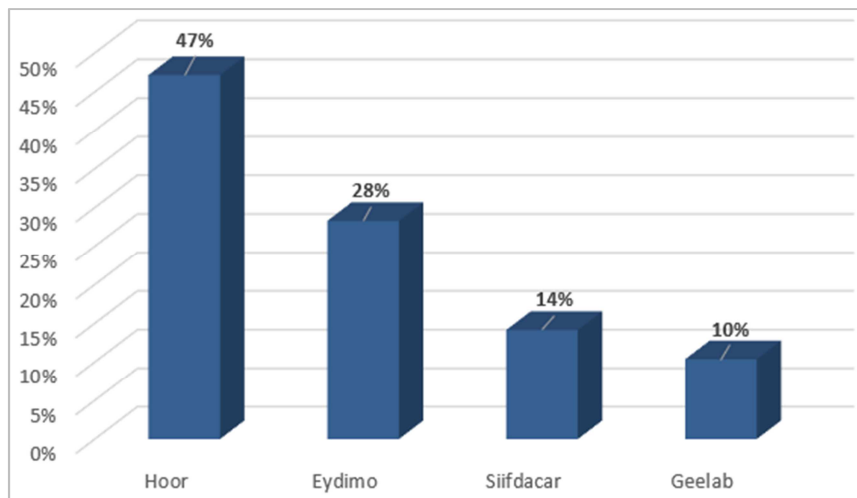


Figure 2. Camel eco-types.

Table 1. Type of housing system.

| Type of house | Frequency | Percent |
|-------------------------|-----------|---------|
| Loose House | 57 | 85% |
| Fenced and tree shelter | 10 | 15% |
| Total | 67 | 100% |

The data in table 1 above show most farms use the type of housing system, with 85% using an open house system and 15% using a fenced and tree shelter house.

The data in table 2 below shows the herd composition of camel farms visited in the outskirts of Mogadishu: 48% were

lactating camels, 4% were dry camels, 25% were heifers, and 23% were bulls, respectively. This result shows that the farms were dual-purpose and produced milk, meat, and replacement camels.

Table 2. Herd size.

| Herd size | Total | Percentage |
|------------------|-------|------------|
| Lactation camels | 2547 | 48% |
| Dry camels | 222 | 4% |
| Heifer Camels | 1346 | 25% |
| Bull Camels | 1200 | 23% |
| Total | 5315 | 100% |

Table 3. Mean Production and Reproductive Parameters of Camel on the outskirts of Mogadishu, Somalia.

| Parameters | Mean, (month) |
|-------------------------------------|---------------|
| Age at first mating (Male) | 81.49 |
| Age at first mating (Female) | 54.90 |
| Age at first calving | 78.72 |
| Calving interval of dromedary camel | 21.76 |
| Lactation length | 19.28 |
| Milk liters/day/camel | 4 L |

The dates in table 3 above show the reproductive parameters of the camel in the outskirts of Mogadishu: age at first mating (male), age at first mating (female), age at first calving, the calving interval of the dromedary camel, lactation length, and milk liters per day per camel. Age of Maturity (Months): The data in table 4. shows the average age of maturity of male and female camels was 81.49 and 54.9 months, respectively. The period at First Calving: The result of the age at First Calving from the data gathered in table 4 shows that the mean age was 78.72 months. The calving interval of dromedary camels and lactation length: The mean calving interval was 21.76 months, and the lactation length was 19.28 months. Average milk production: The data in the table describes that the mean milk production was 4 liters per day per camel.

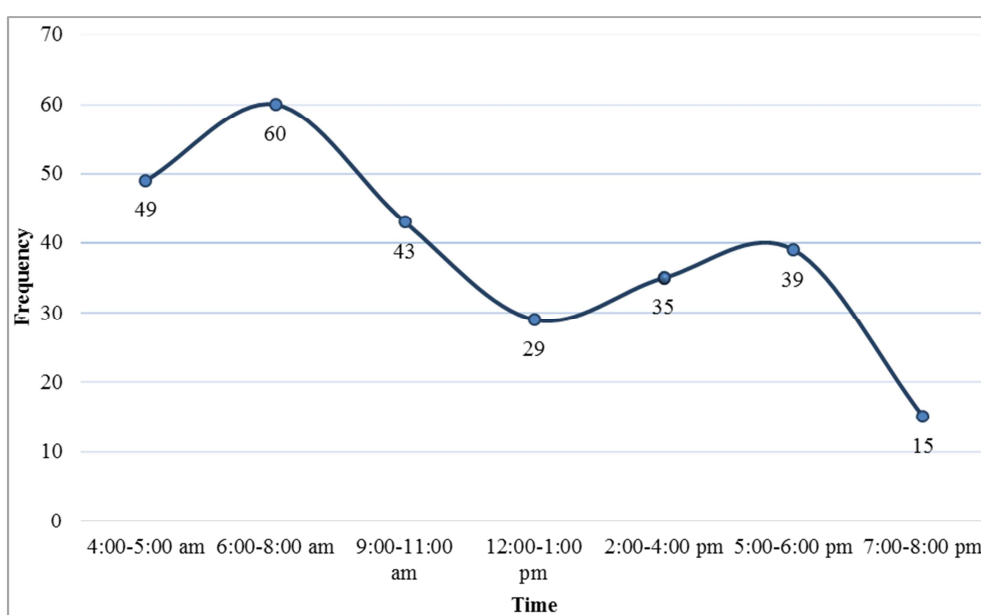
Table 4. How many times were milked per day.

| Milked per day | Frequency | Milking cows | Total liters/day | Average per cow |
|----------------|-----------|--------------|------------------|-----------------|
| Two times | 5 | 122 | 318 | 2.6 L |
| Three times | 11 | 333 | 982 | 2.9 L |
| Four times | 20 | 646 | 2323 | 3.6 L |
| Five times | 18 | 754 | 2955 | 3.9 L |
| More | 13 | 692 | 3782 | 5.5 L |
| Total | 67 | 2547 | 10360 | 4 L |

The above table 4 shows milked performance at various milking frequencies per day. When milked two times, the average per cow/day was 2.6 L, while when milked three times, four times, five times, and more, the standards were 2.9 L, 3.6 L, 3.9 L, and 5.5 L, respectively. This indicates that as milking frequency increases, milk production per cow per day increases steadily.

3.2. Milking Time

In the below line chart explaining the milking time on the farm, 18% of respondents said 4:00–5:00 am, 22% of respondents said 6:00–8:00 am, 16% of respondents said 9:00–11:00 am, 11% of respondents said 12:00–1:00 pm, 13% of respondents said 2:00–4:00 pm, 14% of respondents said 5:00–6:00 pm, and 6% of respondents said 7:00–8:00 pm.

**Figure 3.** Milking time.**Table 5.** Type of roughage use.

| Roughages | Frequency | Percent |
|------------------------|-----------|---------|
| Maize, sorghum (straw) | 50 | 75% |
| Grass | 17 | 25% |
| Total | 67 | 100% |

Table 5 above indicates the type of roughage used. 75% of the respondents said maize and sorghum (straw), and 25% said grass. The majority of the respondents said maize and sorghum (straw).

Table 6. Type concentrate uses.

| Concentrate | Frequency | Percent |
|-------------------------------|-----------|---------|
| Maize, sesame cake, and Bran | 35 | 52% |
| sorghum, sesame cake and Bran | 25 | 37% |
| Wheat, sesame cake and Bran | 7 | 10% |
| Total | 67 | 100% |

The data in table 6 above shows the type of concentrate used. 52% of the respondents said maize, sesame cake, and bran, while 37% of the respondents said sorghum, sesame cake, and bran, and 10% of the respondents said wheat, sesame cake, and bran.

Table 7. Supplement.

| Concentrate | Frequency | Percent |
|---------------|-----------|---------|
| Protein | 7 | 10% |
| Vitamin | 10 | 15% |
| No supplement | 50 | 75% |
| Total | 67 | 100% |

The data in table 7 above explains supplement usage and shows the majority of the farmers: 75% of the respondents said they don't give camels any supplements; 15% said they provide camels vitamins; and 10% of the respondents said they give camels protein. This result shows the majority of farmers don't use supplements.

Table 8. Breeding circumstance.

| Breeding circumstance | Frequency | Percent |
|-------------------------|------------------|---------|
| Inside the farm | 26 | 39% |
| Outside the farms | 21 | 31% |
| Both | 20 | 30% |
| Total | 67 | 100% |
| Breeding technique used | Natural Breeding | |
| | 67 | 100% |

According to table 8 above, which shows breeding circumstances, 39% of respondents said inside the farm, 31% said outside the farm, and 30% said both. And it also shows us the breeding technique used by the farms: 100% of the respondents said natural breeding.

Table 9. Selection of the breeding male.

| Selection | Frequency | Percent |
|----------------------------------|-----------|---------|
| Physical Strength and Appearance | 38 | 57% |
| Pedigree | 29 | 43% |
| Total | 67 | 100% |

According to table 9 above, which shows the selection of the breeding males, 57% of the respondents said physical strength and appearance, and 43% said pedigree.

Table 10. Breeding season.

| Season | Frequency | Percent |
|----------------|-----------|---------|
| Spring (Gu') | 29 | 44% |
| Fall (Dayr) | 29 | 44% |
| Summer (Xagaa) | 9 | 12% |
| Total | 67 | 100% |

According to the above table 10, which shows the breeding season, 44% of respondents said spring (Gu'), 44% of respondents said fall (Dayr), and 12% of respondents said summer (Xagaa).

Table 11. The primary purpose of rearing camel farms.

| Purpose | Frequency | Percent |
|------------------|-----------|---------|
| For milk purpose | 35 | 52% |
| Double purpose | 32 | 48% |
| Total | 67 | 100% |

The data above table 11 indicates the purpose of rearing camel farms in the outskirts of Mogadishu: 52% of the respondents rear for milk purposes, and 48% rear for dual purposes. The majority of farms' primary goal was milk

production.

Table 12. Health status of the herd.

| Health Status | Frequency | Percent |
|---------------|-----------|---------|
| Poor | 11 | 16% |
| Good | 27 | 40% |
| Very good | 23 | 34% |
| Excellent | 6 | 9% |
| Total | 67 | 100% |

In the data above table 12 indicates the herd's health status. 16% of the respondents said poor, 40% said good, 34% said very well, and 9% said excellent.

Table 13. Adaptability camels in the farms.

| Adaptability | Frequency | Percent |
|--------------|-----------|---------|
| Poor | 25 | 37% |
| Good | 27 | 40% |
| Very good | 15 | 22% |
| Total | 67 | 100% |

According to the above table 13 explains the adaptability of camels on farms. 37% of the respondents said poor, 40% of the respondents said good, and 22% of the respondents said very well.

Table 14. Challenges faced in farms.

| Challenges | Frequency | Percent |
|-------------------|-----------|---------|
| Disease | 16 | 24% |
| High cost of feed | 27 | 40% |
| Poor market | 6 | 9% |
| Lack of knowledge | 18 | 27% |
| Total | 67 | 100% |

The data in table 14 shows the challenges faced by farmers. Most farmers, 40% of respondents, said the high feed cost, 27% lacked knowledge, 24% said disease and 9% reported a poor market.

4. Discussion

During this survey, we visited 67 intensive and semi-intensive camel dairy farms on the outskirts of seven districts in Mogadishu, Somalia, and conducted interviews using a semi-structured questionnaire. Hence, in this study, according to the ecotype of camel, 47% were Hoor, 28% were Eydimo, 14% were Siifdacar, and 11% were Geelab. Nonetheless, the current investigation is comparable to the study [18]. Four subtypes of Somali breeds are categorized: Hoor, Geelab, Siifdacar, and Eydimo. The Hoor camels produce the most significant volumes of milk. The herd makeup of camel farms visited on the outskirts of Mogadishu was as follows: 48% were lactating camels, 4% were dry camels, 25% were camel heifers, and 23% were camel bulls. The high percentage of lactating camels indicates that the farms were actively producing milk.

In contrast, the presence of heifers and bull camels suggests they were also focused on Breeding and expanding their herds.

The Age of Maturity Months of male and female camels

were 81.49 and 54.9 months, respectively. The Age at First Calving months was 78.72 months. The calving interval of the dromedary camel and lactation length was 21.76 months and 19.28 months, respectively. Similarly reported by the study [12]. In this study, the average milk production was 4 liters per day per camel, which matches the study reported by Simenew, K. etc. [22]. This study strongly agrees [16]. Female camels reach puberty between 3.9 and 4.7 years old, while males reach puberty between 5.5 and 6.5 years old. On average, female camels give birth at five years old, with the lowest age at first calving recorded at 4.95 years and the longest at six years. The calving interval is typically two years, ranging from 18 months to two years. Lactation lasts about a year, although some individuals have had lactation durations ranging from six months to two years.

The milked performance at various milking frequencies per day when milked two times, the average per camel per day was 2.6 L, while when milked three times, four times, five times, and more, the averages were 2.9 L, 3.6 L, 3.9 L, and 5.5 L, respectively. This milking performance indicates that as milking frequency increases, milk per camel per day increases steadily. During this survey, the average milk production per camel daily (5.5 ± 2.6 L) was more significant than the daily off-take rate per camel, previously reported as 5.2 ± 2.2 L in Shinile and Jijiga zones [19]. It was observed that the camel milking frequency ranges from two to six times daily, depending on the season, stage of lactation, and milk production, as mentioned in Faisalabad [3]. According to their selection of the breeding male, 57% of the respondents said physical strength and appearance, and 43% said pedigree. This study is similar to what was reported by Simenew, K. etc. [21]. The selection of Somali herd owners and top breeding males was based on several factors, including appearance, physical strength, skin color, height, and behavior, as well as the traits of their ancestors, such as milk production, color, and resistance.

According to the breeding season of the outskirts of Mogadishu, 44% of the respondents said spring (Gu'), 44% of the respondents said Fall (Dayr), and 12% of the respondents said Summer (Xagaa) [13]. Reported by the breeding season for Afar camels is primarily in September and December, during cooler weather that may be linked to better feed availability. Similar to the report by Elmi, A. A. [6] breeding occurs during the spring and falls rainy seasons, and effective management of male breeding camels is crucial for success. This management is shared among Somalis, who exercise significant control over their male breeding animals.

Regarding the primary purpose of rearing camel farms, 52% of respondents said for milk purposes, and 48% for Double purposes. The majority of the farms were rearing for milk purposes [8] this study reported that they serve various purposes, with the males mainly used for meat production and the females used primarily for milk production. Another study was similarly reported by Faraz, A. etc. [8]. The primary reason for domesticating camels was to produce milk. Camels hold significant value for pastoralists and agro-pastoralists due to their ability to produce more milk than any

other domesticated animal species in arid and semi-arid regions, especially during prolonged drought conditions.

According to the current study, 75% of the respondents reported using maize and sorghum straw as roughage, while 25% used grass. The majority of respondents preferred maize and sorghum straws. Regarding concentrate usage, 52% of respondents used maize, sesame cake, and bran, 37% used sorghum, sesame cake, and bran, and 10% used wheat and sesame cake, and bran. According to the survey, 75% of farmers said they do not use supplements, 15% reported using Vitamin supplements, and 10% reported using Protein supplements. Seifu, E. [19] documented by camels in shinile and jigjiga zones, supplemental feed is not given to mature camels but is occasionally given to calves. This result aligns with the [24] observation that camels graze on grass only when there is a shortage and browse mostly on trees and bushes. Additionally, it is common for farmers only to provide supplementary feeds for salt, which is given every two to three months.

According to the survey, farmers encounter diverse challenges. A significant proportion of the respondents, precisely 40%, identified high feed expenses as their primary challenge. The second most frequently mentioned problem was insufficient knowledge, with 27% of the respondents acknowledging it as a barrier. Meanwhile, 24% of the participants reported disease as a concern, and only 9% mentioned poor market conditions. These findings are consistent with the observations made by Seifu, E. [19] in a similar study, where he noted that feed shortage and disease prevalence are the primary constraints to camel production in Shinile and Jijiga zones.

According to the study's findings, farmers most frequently utilize the loose housing system, which accounts for 85% of the farms assessed, with the remaining 15% using fenced and tree shelter houses. This result contrasts with the finding [16] in a previous study, which noted that camels are usually maintained in traditional kraals at night and herded during the day on communal grazing fields. These kraals are built from prickly plants and tree branches to keep homesteads.

5. Conclusion

The study highlights the challenges encountered in the process of intensification of camel husbandry in Mogadishu. One of the significant challenges identified is the need for more knowledge among camel herders about proper feed preparation and animal management, as well as housing problems and poor infrastructure. Disease prevalence is also significant in reduced camel herds' productivity and reproduction. Moreover, camels need help adapting to human food, which may not suit their nutritional needs, and they need to be provided with additional supplements. The most incredible difficulty experienced by camel owners is the high cost of feed, which can be attributed to the scarcity of grazing lands and the unpredictable changes in the market value of feed. These fluctuations in the feed cost significantly impact the economic sustainability of camel husbandry practice.

6. Limitations

The limitations we faced were time limitations and sample size was small.

Conflict of Interest

The authors have declared no conflict of interest associated this study.

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