

Characteristics and Determinants of Dromedary Camel (*Camelus dromedarius*) Production in Borana Plateau, Ethiopia

Roba Jiso*, Yisehak Kechero² Asrat Guja²

1, Department of Animal Sciences, Arba Minch University, Arba Minch, Ethiopia

*Correspondence to rjelema@gmail.com

Roba Jiso (Corresponding author)

PO box 21, Arba Minch, Ethiopia

Abstract

Drought mitigation strategies using dromedary camel production and lifestyle diversification are gaining popularity in the Borana plateau, Ethiopia. Borana villages have recently emphasized camel care as a strategy for responding to the severity of periodic droughts. Although Borana pastoralists are becoming more interested in camel management, the underlying causes of the region's expanding camel population have yet to be addressed. Despite available information on the characteristic of camel herders and determinants of production, the appropriate policy for the commercialization of camel potential has been hampered. The purpose of this study was to investigate the demographic characteristics and determinants of camel production. The variables of interest were; sources of income, culture, sources of starting camels, years of rearing experience, reasons for keeping camels, herd structure, and compositions, and availability of feed and water sources. A cross-sectional study design was conducted in the Yabelo, Elwaye, and Gomole districts of the Borana zone. The household survey; a structured survey questionnaire, a participatory focused group discussion (FGD), and key informant interviews (KII) were used. A total of 364 household interviews, 3 FGDs, and 12 KIIs were conducted to understand the depths of the socio-economic characteristics and determinant factors of camel production. Data were analyzed by descriptive statistics in all the parameters tools using SPSS version 21. The Chi-square tests were conducted to evaluate the dependence between tribes' affiliations and categorical variables. Demographic characteristics, sources of income, origins of camels, years of rearing experience, reasons for maintaining camels, herd structure, and compositions were not significantly different ($P < 0.05$), according to the findings. The study revealed that the camel production determinants between the ethnic affiliations were also significant differences ($p < 0.05$) between the ethnic groups and study areas. The findings were contradicting the expectation that different socioeconomic characteristics of camel herders and determinant factors among tribes. Therefore, this finding could be forwarded, a need for a comprehensive camel production policy as well as regulatory interventions for camel pastoralism in the study areas. and addressing other promotions on camels as "animal of the future"

Keywords: Camel herders, Camel production, pastoralists, Borana, Ethiopia

DOI: 10.7176/RHSS/12-13-03

Publication date: July 31st 2022

Introduction

Camelus dromedarius raising is a novel form of pastoral living in the Borana plateau (Bekele, 2019). The camels are among the most prevalent species of domestic animals kept in Borana pastoralist areas by diverse tribes. The most common livestock species are; cattle, goats, sheep, equines, and chickens (Abdulahi, 2020). The Borana, Gabra, Dogodia, and Guji are among the Oromo ethnic groups practicing camel pastoralism in Borana Plateau. Traditionally, the Borana and Guji tribes are known for cattle pastoralism while the Gabra and Dogodia are camel pastoralist tribes. However, the Borana and Guji have engaged in camel pastoralism for decades (Giro and Jilo, 2020). Camel keeping is gaining popularity in non-traditional camel keeping groups (Megersa et al., 2011). Pastoralists and agro-pastoralists living in fragile regions rely heavily on camels for their livelihoods (Ishag and Ahmed 2011; Gebremichael et al., 2019). It has been demonstrated that pastoralists who rely on camel herding for a living have benefited from the adoption of camel pastoralism and husbandry practices (Watson et al., 2016; Habte et al., 2019; Elias et al., 2020).

Because camel production is limited to pastoral areas, understanding the socio-economic characteristics and determinants of camel herders who practice camel pastoralism is vital for the current status of the camel. Cattle production, on the other hand, was acknowledged as one of the most successful in the Borana plateau. However, camel production is said to be impacted by culture and religion, notably in Ethiopia. Camel production, on the other hand, makes a considerable contribution to the livelihoods of the broader population in most of the country's neglected areas. Camel production has received little attention, and a lack of understanding has limited crucial resources to a single way of production.

The lack of information, it was hypothesized, hampered the development of an adequate plan to capitalize on the camel's potential in the research area. Inspection of camel owners' socioeconomic features and the

determinant of camel production in ethnic connections in three areas is critical. As a result, the goal of this research was to better understand the socioeconomic features of camel herders and the factors of camel production to close the gap and provide appropriate techniques for recognizing camel herders' production potential in the study area.

Materials and methods

Study area

The research was carried out in three districts of the Borana Zone, Southern Ethiopia (Yabello, Elwaye, and Gomole). Yabello district and Yabello town are different. Yabello district is the rural area while Yabello town is the zone's administrative center and the town where the zone's administrative bodies are located. It is located 570 kilometers south of Addis Ababa and is geographically located at 50 23'49 N latitude and 390 31'52 E longitude. Elwaye town is located 27 kilometers west of Yabello district, at an elevation of 1327 meters above sea level, 4°52'N 38°5'E latitude, and 4.884°N 38.082°E longitudes, while Gomole district is located 30 kilometers north of Yabello town, at an elevation of 1857 meters above sea level, 4°52'N 38°5'E latitude, and 4.884°N 38.082°E longitudes. The rainfall pattern is bimodal, with a mean annual rainfall of 500 mm and significant inter-annual variability (Angassa and Oba, 2007). The majority of annual rainfall (70 percent) falls during the main rainy season (March to May), with the remaining 30 percent falling during the short rainy season (September to November) (Megersa et al., 2014). The average annual temperature is 24 degrees Celsius, with minimum and maximum temperatures of 17 and 28 degrees Celsius, respectively (Megersa et al., 2014). **Figure 1** Map showing study kebeles of (Yabelo, Elwaye, and Gomole) districts.

Sampling Design and data collection

The survey was conducted in the Borana Zone's Yabello, Elwaye, and Gomole districts, which are located in the south and share a long border with Kenya. From January to September 2021, fieldwork was conducted. Household heads, key informants, and group talks in the separate kebeles provided primary data, while secondary data was received from several concerned line offices.

Sampling produces

A three-stage sampling process was used to pick camel herder samples. First, Yabello, Elwaye, and Gomole were picked for their camel population, market availability, and road accessibility. Second, the same approach was used to pick three kebeles from each district. Third, a random sample approach was used to contact camel herder homes. Yamane (1967) gave a simple formula for calculating the required sample size, which was employed.

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

Where: n = is the representative sample size, N = is the total household head in the selected nine kebeles in three districts and e = (5%) is the level of precision defined to determine the required sample size at a 95% confidence level since the camel herders have a homogenous production system and social values.

Total 364 camel herders were interviewed in the Yabello, Elwaye, and Gomole districts (Dharito, Areri, Dambi, Dhedhertu, Elwaye Golba, Adegalchati, Buya, Surupha Badiya, and Haro Bake, respectively). Data was collected through a household survey, a structured survey questionnaire, a participatory focused group discussion, and key informant interviews. The questionnaire was administered in the local language through face-to-face interviews (Afaan Oromoo).

Data analysis

SPSS version 21 was used to analyze the gathered data descriptively. Categorical variables were evaluated using Chi-square testing. The level of significance between variables was set at $P < 0.05$.

Results and Discussion

Demographic Characteristics of Camel herders

According to the findings of this study, males made up 89.6% of the respondents, while female-headed households made up 10.4% of the herders (Table 1). In terms of marital status, 85.4 percent of respondents were married, while around 6.0 percent were divorced or widowed. In terms of education, 91.8 percent of respondents never went to formal schools, while 8% went to non-formal schools. Overall, 33.8 percent of those who responded were between the ages of 31 and 45, and 56.6 percent were 46 and higher. The average family size of respondents herding camels in the current survey was 9 for Guji and 8 for Gabra, respectively. Herders in the research area had an average family size of seven.

According to the socio-demographic data collected from camel owners, the majority of respondents (89.6%) were men, indicating that men were the heads of households and held the bulk of decision-making positions. This finding is in line with (Ibrahim, 2021), which found that most camels in pastoral areas were male and that

only a small percentage of female-headed families possessed camels. 85.4 percent of married couples had their marital status determined, with the majority of families living together with their husband and wife. Furthermore, 91.8 percent of camel owners never attended a formal school which had an impact on camel production in the areas surveyed, according to the report (Baloch et al., 2018). Camel herders aged 46 and up made-up 56.6 percent of the total. According to Keskes et al. (2015), education was very low throughout the range of places surveyed, and the majority of respondents were illiterate (94%) while the remaining (6%) only got primary education.

Sources of Income for the Respondent Households

The principal sources of income for respondent households, as well as the relationship between clan memberships, were investigated in this portion of the questionnaire (Table 2). Animal husbandry is the principal source of income for 92.6 percent of respondents, according to the report. Crop cultivation, on the other hand, is listed as the household's second source of income by 88.5 percent of respondents. While livestock trade provided 40.7 percent of family income, casual labor provided 13.7 percent, rental housing provided 11.3 percent, forest product sales provided 5.5 percent, and petty trades provided 11.0 percent.

The majority of respondents said that livestock rearing was the most prevalent source of household income, followed by crop cultivation. This finding is in line with the findings of (Bekele, 2019), who claimed that herders' livelihoods in the study areas are predominantly dependent on livestock production, with a limited variety of resources being employed to produce money and meet domestic needs. This is in line with the findings of Abdullahi et al. (2020), who observed that socioeconomic indicators including total livestock unit, farm revenue, non-farm income, and herd size all had a positive impact on pastoralism's likelihood. Almost all pastoralist sources of income, including livestock sales, daily labor, charcoal and firewood sales, and crop production, contribute to household income, according to Yosef et al. (2013).

Sources of Starting Camels for the Respondent Household

Using descriptive statistics, the interviewees' tribes' sources for starting camels were investigated. The survey data in (Table 3) shows where respondents got their first camels. The stated camels were inherited by 48.9% of respondents, while 38.5 percent bought them. 52.4 percent of Borana and Dogodi people have bought their first camel, while 50.0 percent of Guji people have bought their first camel. Gabra's forefathers inherited camels in 71.1 percent of cases.

The majority of Gabra and Dogodi were ancestral camel herders, according to this survey. This indicates a strong traditional affinity between camels and both tribes, with Borana and Guji providing similar experiences. The first camels were said to have been purchased from Borana and Guji tribes, showing a growing interest in camel breeding. The statement was unanimous (Ibrahim, 2021). The majority of Gabra and Dogodi respondents said their parents had given them camels. According to Noor et al. (2013), camel inheritance is a frequent practice among African Muslim tribes. Another source provided the average number of Guji who had begun camels purchased. According to an important informant, the study area was prone to tribe conflict, with animal buzz and hijacking occurring during inter-ethnic conflicts. Overall, the findings demonstrate that the majority of camels were inherited among tribes and that the purchased camels were documented as acted adoption methods for Borana and Guji, rather than historical linkage. This indicates that camel pastoralism was more familiar to the Gabra and Dogodi tribes.

Years of Rearing Experience of Respondent Ethnic groups

The majority of respondents (71.1 percent, 70 percent, 68.5 percent, and 50 percent of Dogodia, Gabra, Borana, and Guji, respectively) had more than 21 years of keeping experience, according to the findings of this study (Table 4). Overall, 69.2 percent of respondents had more than 21 years of camel rearing experience, and 17.3 percent of respondents had 11-20 years of camel pastoralism experience. Between ethnic groupings, there was no statistically significant difference ($P < 0.05$).

The camel owners in the research locations had an average of more than 21 years of herding experience, indicating that they have more conventional camel husbandry experiences. Long herding experiences of camel owners may be valuable in the implementation of current camel management practices. This study also found that tribes had similar herding histories, hinting that any camel-supporting approaches could follow suit. The findings contested (Bekele, 2019), who claimed that pastoralists in the study areas suggested that most pastoralists in Southern Oromia did not raise camels before two decades. Camel rearing of Borana and Guji tribes began on average 25.93 years ago, according to Gabisa (2015). The length of time that tribes were involved in camel production, on the other hand, varied. In contrast to the Gabra, the Borana community's involvement in camel production is an emerging attempt to diversify as a coping mechanism for repeated drought.

Reasons for keeping Camels

The majority of respondents (71.1 percent, 70 percent, 68.5 percent, and 50 percent of Dogodia, Gabra, Borana, and Guji, respectively) had more than 21 years of keeping experience, according to the findings of this study (Table 5). Overall, 69.2 percent of respondents had more than 21 years of camel rearing experience, and 17.3 percent of respondents had 11-20 years of camel pastoralism experience. Between ethnic groupings, there was no statistically significant difference ($P < 0.05$).

The camel owners in the research locations had an average of more than 21 years of herding experience, indicating that they have more conventional camel husbandry experiences. Long herding experiences of camel owners may be valuable in the implementation of current camel management practices. This study also found that tribes had similar herding histories, hinting that any camel-supporting approaches could follow suit. The findings contested (Bekele, 2019), who claimed that pastoralists in the study areas suggested that most pastoralists in Southern Oromia did not raise camels before two decades. Camel rearing of Borana and Guji tribes began on average 25.93 years ago, according to Gabisa (2015). The length of time that tribes were involved in camel production, on the other hand, varied. In contrast to the Gabra, the Borana community's involvement in camel production is an emerging attempt to diversify as a coping mechanism for repeated drought.

Camel Herd Structure of tribe groups

The tribe's reasons for camel pastoralism were shown in (Table 6). The survey result shows that about 66.2 percent reported that camels can withstand the impacts of dry seasons more than cattle. While 90.7 percent of camel herders indicated camel has a societal prestige, 70.1 percent of respondents believed that keeping camels was to produce milk. On the other hand, 56.3 percent of respondents disagreed that they knew about camel husbandry, and 61.1 percent of Gabra disagreed that they grew up knowing camels as a basis for camel rearing. Dogodi answered with 82 percent, Borana with 29 percent, and Guji with 75 percent. This result is in line with that of Bekele et al. (2021), who found that climate change promotes repeated drought, which leads to cattle deaths. The Borana tribe was claimed to have large participation in camel purchased and managed for diversification because of their ability to adapt to recurrent droughts and their milk production, according to Wako (2017). The key justification for retaining camels, according to Idris et al. (2017), is that they are drought-resistant animals when compared to other livestock. Camel herders are a highly reasonable human adaptation to tough and adverse environmental harsh zones (Albaba, 2014). Yosef et al (2013) observed that Borana cattle holdings have declined by 60% in the last two decades, while the number of households switching to camel herding has increased. Borana people are diversifying their income streams by focusing on dairy camel production and milk demand. The fundamental purpose of camel husbandry was recognized by 90.7 percent of camel herders as societal prestige. However, there is no statistical difference in camel social esteem between tribes ($P < 0.05$). Bekele et al. (2019) found that rearing camels were highly appreciated by populations in Borana pastoralist areas. This finding is in line with that of Yosef et al (2013), who discovered that in the Borana tribes, household social standing has risen in recent years as camel numbers have increased. Similarly, the quantity of camels owned has an impact on Afar and Somali prosperity. 70.1 percent of respondents agreed on the entire milk production capacity and the purpose of keeping camels. The potential for camel milk production as a motive for camel husbandry differs significantly ($P < 0.05$) amongst the tribe. On the other hand, 56.3 percent of respondents disagreed with knowing about camel husbandry, whereas 61.1 percent of Gabra answered differently about growing up with knowing camel as a cause for camel rearing. Dogodi had 82 percent of the vote, Borana had 29 percent, and Guji had 75 percent. The motive for camel breeding was agreed upon by 76.9% of respondents as commercial value. When it comes to the commercial worth of camels as the principal reason for keeping camels rather than other livestock species, there is a significant difference ($P = 0.001$) among responders. One of the key reasons that camel production has been practiced among traditional cattle herders such as Borana is that camels are resistant to repeating droughts, according to the findings of this study. Drought has been a frequent occurrence in Borana for about three decades, resulting in the loss of many animals by pastoralists. Camels have a high Social Prestige value in the research locations. Those households who own a camel, which has a great value when compared to other animals, are praised by the community. Yosef et al. (2013) discovered that the Borana tribe with fewer than 5 camels is classed as having a medium degree of wealth. Camel milk production capacity, as well as at least two milkings each day, distinguishes camels from other domestic species.

According to the majority of respondents, knowing the camel and its management exposures is crucial to staying in the camel herding business. Another motive for keeping the camel was its commercial worth. Camel prices are significantly greater than those of any other animal species in the same years. The herders' ability to continue camel herding is likewise influenced by money conversation values.

Camel Production and settlement System

The respondent's family Camel herder size was mostly she-camel, with only a few mating males present in the research region (Table 7). Nearly 86.8% of respondents said they had a camel herd with fewer than ten heads in the last five years. The majority of respondents (37.9%) said their herds do not have any breeding males. 86.0 percent of responders said there were less than ten heads of camels in their herds.

According to Shuiep et al. (2014), in pastoral production systems, camel herds are predominantly made up of high-yielding lactating she-camels. The number of she-camel holdings in herds across camel herders in the research locations does not differ significantly ($P < 0.05$). Gabisa (2015) discovered that herd structure varied depending on the category. Camels are traditionally housed according to their compositions, with camels of comparable categories sharing housing or settings. The camel herd composition of Afar pastoralists is roughly 87.5 percent female camels, according to Belete et al (2019). This indicates that pastoralists care more about the number of the herd than the individual animals' quality.

This study discovered that in the last 20 years, the average camel herd size owned by a person was 26.9%, 69.2%, 3.85%, and 5-10 heads, 10-15 heads, and >15 heads, respectively.

This is in line with the findings of Keskes et al. (2015), who found that 59 percent of camel herders kept only one breeding male, while only 8% of Somali pastoralists kept three breeding males. According to Bekele (2020), 73.9 percent of camel caretakers own breeding bulls born in their herds. While 19.6% of camel owners borrowed bulls from their neighbors. Inbreeding occurs because most herders have a restricted number of breeding males, according to Shuiep et al. (2014). Keskes et al (2015) found a male to female camel ratio of 1:13 in their study. Meanwhile, Yirda et al. (2020) reported that camel herd sizes range from hundreds to thousands per family, with female camels in reproductive groups having a greater male-female ratio than male camels. Pastoralists, on the other hand, believed that retaining male camels in the herds was contingent on calf production. Most herders in the study areas used traditional male selection for breeding. This means that the primary goals of camel farming are milk production and calf reproduction (Babege, 2021). Camel breeding is primarily focused on calf production and reproduction (Babege, 2021). Females are also chosen based on their pedigree, size, udder, and overall health. When it comes to keeping breeding male camels in their herds, there is a substantial difference ($P < 0.001$).

Family member's roles in camel management

According to the results of the management responsibilities of family members survey, 41.3 percent of respondents said men influenced camel management (Table 8). A management function was held by 28.8% of women and 27.3 percent of children. According to the poll, 2.8 percent of respondents kept their camels with relatives.

Camel management was addressed as a family member's function and obligation in the study location. Herding, milking, watering, calf care, salt management, and disease inspection were among the camel management activities. The outcomes of this study demonstrate that men were in charge of the accumulative management tasks, while women and children also played a significant part in milking and calf management. Children's specific responsibilities include daily herding and keeping daily reports. During a focused group discussion among the participants, it was noted that daily reporting of children is vital to the owner in terms of the health characteristics of the particular animal by observing feeding and water activities. According to Salamula et al. (2017), practically all members of the household were involved in various camel management tasks, and defined roles and responsibilities were assigned. This finding is supported by Tadesse et al (2015), who found that all camel management tasks are divided among family members, except breeding and marketing decisions, which are mostly the responsibility of men.

Seasonal availability of watering feeds resources and disease

According to the survey, 67.1 percent of camel water comes from the rainwater collection structure, which is a pond. While 22.1 percent said traditional wells would be the camel's next water supply (Table 9). According to the report, herders believe that 19.6% of camel diseases are caused by unknown sources, 18.8% are caused by dietary deficiencies, and 16.4% are caused by parasite infections.

During wet seasons, 60.8 percent of camel feed comes from communal grazing areas, whereas 26.4 percent comes from communal Kalo during dry seasons. During the dry season, however, camels have access to 26.4 percent communal Kalo and 24.1 percent farmland when crops are harvested.

The study area's seasonal availability of feed and water supplies were depicted as common grazing land and pond. The key informant interviews and focus groups revealed that feed and water availability were major camel production variables in the research locations. Different scholars supported this finding, reporting natural grazing and water sources as key feed resources in pastoralist communities (Tesfa et al., 2021; Derara et al., 2020; Habte et al., 2019). Tadele (2019) conducted a study in the same locations and found that the main water resources in Borana areas that might service livestock in all seasons are ponds, traditional wells, and boreholes. Furthermore, the availability of water and feed supplies throughout the season is the most important factor in herd mobility.

The study regions' feeding and water resource management are subject to a complicated series of restrictions, rules, and regulations that are enforced by selected agents known as "Aba Dheeda and Aba Herega" under the supervision of traditional elders.

Conclusion

The goal of this study was to learn more about the characteristics and determinants of dromedary pastoralism, as well as the tribe's ties. According to the data, the Borana, Gabra, Dogodi, and Guji tribes are the main practitioners of camel pastoralism in the Borana plateau. Survey data and in-depth interviews with camel herders from four tribes who keep camels were evaluated. The results confront expectations that camel herders from different tribes have varied socioeconomic traits and factors. As a result, this research found no significant differences in the characteristics and determinants of camel pastoralism amongst four tribes of camel herders in the study area. As a result, we advocate for comprehensive camel production strategies and regulatory actions. and dealing with other parts of the film's production.

References

- Abdulahi, A., Babege, K., & Zuma, A. (2020). Determinants of Pastoralists Choice of Camel Production and Production Systems in Eastern Ethiopia. *Review of Agricultural and Applied Economics (RAAE)*, 23(1340-2021-011), 12-20.
- Albaba, I. (2014). Current Status of Camel Husbandry and Production in the West Bank Governorates-Palestine.
- Amante, D. G. (2014). Traditional camel management as an adaptation strategy to ecological changes: The case of Karrayyuu Oromo of Ethiopia (Master's thesis, UiT Norges arktiske universitet).
- Amsidder, L., Alary, V., & Sraïri, T. M. (2021). An empirical approach to past and present mobility management in the desert societies of camel breeders in South Eastern Morocco. *Journal of Arid Environments*, 189, 104501.
- Angassa, A., & Oba, G. (2007). Relating long-term rainfall variability to cattle population dynamics in communal rangelands and a government ranch in southern Ethiopia. *Agricultural Systems*, 94(3), 715-725.
- Babegge, K., Wandara, S., & Lameso, L. (2021). Potential of camel production and management Practices in Ethiopia. *Journal of Dryland Agriculture*, 7(5), 67-76.
- Baloch, M. H., Shah, A. H., Nizamani, Z. A., & Rajput, M. N. (2018). Socio-Economic Characteristics of Camel Farmers in Different Zones of Sindh, Pakistan: Department of Livestock Management, Sindh Agriculture University, Tandojam, Pakistan. *Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences*, 34(2), 161-167.
- Bekele, B., Oneta, A., Kumbe, A., & Husein, B. (2021). Indigenous knowledge on camel milk and camel milk products hygienic handling, processing and utilization in Borana Area, Southern Ethiopia. *J Food Sci Nutr The*, 7(1), 025-032.
- Bekele. B. (2019). Assessment of production systems of camel populations under pastoral management in southern Oromia, Ethiopia. *International Journal of Engineering Applied Sciences and Technology*, 4(7): 24-28.
- CSA (2018) Agricultural Sample Survey 2016/2017: Report on Livestock and Livestock Characteristics (private peasant holdings) Addis Ababa Ethiopia 2: 9-13
- Derara, A., & Bekuma, A. (2020). Study on Livestock Feed Resources, Biomass Production, Feeding System and Constraints of Livestock Production in Relation to Feeds in Weliso District, South West Shoa Zone, Ethiopia. *Journal of Biogeneric Science and Research*, 5(1).
- Elias, M., Hailu, Y., & Jilo, K. (2020). Prevalence, risk factors and species diversity of ixodid ticks that parasitize dromedary camel in Yabello District of Borana Zone, Southern Ethiopia. *Journal of Parasitology and Vector Biology*, 12(2), 52-59.
- Gebissa, D. T. (2015). Husbandry practices and utilization of camel products in the Borana zone of southern Oromia, Ethiopia. *Science Research*, 3(4), 191-197.
- Gebremichael, B., Girmay, S. & Gebru, M.(2019). Camel milk production, and marketing: Pastoral areas of Afar, Ethiopia. *Pastoralism* 9. <https://doi.org/10.1186/s13570-019-0147-7>
- Giro, A., & Jilo, K. (2020). Prevalence of camel trypanosomosis and associated risk factors in Arero district, Borena Zone, Southern Ethiopia. *International Journal of Veterinary Science and Research*, 6(1), 014-022.
- Habte Abaya, A. M., Tamir, B., Assefa, G., & Feyissa, F. (2019). Feed Resources Availability and Feeding Practices of Smallholder Farmers in Selected Districts of West Shewa Zone, Ethiopia. *World Journal of Agricultural Sciences*, 15(1), 21-30.
- Habte, M., Eshetu, M., Andualem, D., Maryo, M., & Legesse, A. (2021). The inventory of camel feed resource and the evaluation of its chemical composition in south-east rangelands of Ethiopia. *Veterinary Medicine and Science*, 7(4), 1172-1184.
- Ibrahim, H. (2021). Socio-Economic Characteristics of Camel Farmers and Types of Feed Resources Offered to

- Dromedary Camels as Supplement in Northwestern Nigeria. *Nigerian Journal of Animal Science and Technology* (NJAST), 4(3), 105-113.
- Idris, A. O., Alhelo, A., ElBukhary, H. A., Eisa, M. O., Ishag, I. A., & Bakheit, S. (2017). Camel Herd Composition and Milk Yield in Central Libya.
- Ishag I A and Ahmed M-K (2011). Characterization of the production system of Sudanese camel breeds. *Livestock Research for Rural Development*. Volume 23, Article #56. Retrieved November 14, 2021, from <http://www.lrrd.org/lrrd23/3/isha23056.htm>
- Kebede, S., Animut, G., & Zemedu, L. (2015). The contribution of camel milk to pastoralist livelihoods in Ethiopia.
- Megersa, B., Biffa, D., Abunna, F., Regassa, A., Godfroid, J., & Skjerve, E. (2011). Seroprevalence of brucellosis and its contribution to abortion in cattle, camel, and goat kept under pastoral management in Borana, Ethiopia. *Tropical animal health and production*, 43(3), 651-656.
- Megersa, B., Markemann, A., Angassa, A., & Valle Zárate, A. (2014). The role of livestock diversification in ensuring household food security under a changing climate in Borana, Ethiopia. *Food Security*, 6(1), 15-28.
- Mehari Y, Mekuriaw Z and Gebru G . (2007): Potentials of camel production in Babilie and Kebribeyah woredas of the Jijiga Zone, Somali Region, Ethiopia. *Livestock Research for Rural Development*. Volume 19, Article #58. Retrieved November 14, 2021, from <http://www.lrrd.org/lrrd19/4/meha19058.htm>
- Noor, I. M., Guliye, A. Y., Tariq, M., & Bebe, B. O. (2013). Assessment of camel and camel milk marketing practices in an emerging peri-urban production system in Isiolo County, Kenya. *Pastoralism: Research, Policy and Practice*, 3(1), 1-8.
- Rafu, O., Tulu, D., & Negera, C. (2021). Camel Trypanosomosis in Yabelo and Gomole Districts in Ethiopia: Prevalence and Associated Risk Factors Based on Parasitological Examinations. *Veterinary Medicine: Research and Reports*, 12, 87.
- Salamula, J. B., Egeru, A., Asimwe, R., Aleper, D. K., & Namaalwa, J. J. (2017). Socio-economic determinants of pastoralists' choice of camel production in Karamoja sub-region, Uganda. *Pastoralism*, 7(1), 1-10.
- Shuiep, E. S., El Zubeir, I. E. M., & Yousif, I. A. (2014). Socioeconomic aspects of rearing camels under two production systems in Sudan. *Development*, 26, 11.
- SPSS (Statistical Packages for Social Sciences) (2012). SPSS (Version 21). Statistical Packages for Social Sciences (SPSS) INC. Chicago, Illinois, USA
- Tadele, D., & Lelisa, A. (2019). Assessment of water resources management and past works on water points development in Borana Rangelands, Southern Oromia, Ethiopia. *International Journal of Water Resources and Environmental Engineering*, 11(2), 39-44.
- Tadesse, Y., Urge, M., Kesari, P., Kurtu, Y. M., Kebede, K., & Abegaz, S. (2015). Socioeconomic profile and gender characteristics in relation to camel management practices in the pastoral communities of Ethiopia. *J. Economics and Sustainable Development*, 6(1), ISSN-2222.
- Tesfa, A., Asmare, Z., Bitew, A., Meseret, M., Lakew, E., Lulie, B., ... & Amanie, A. (2021). On-Farm Monitoring of Northwestern Highland Goat under Traditional Management in Amhara Region, Ethiopia. *Livestock Research Results*, 799.
- Wako, G., Tadesse, M., & Angassa, A. (2017). Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes*, 6(1), 1-12.
- Watson, E., Hassan H and Hallo D. (2016). Camels and Climate Resilience: Adaptation in Northern Kenya. *Human Ecology*, 44:701–713.
- Yemane Taro. (1967). "Statistics: An Introductory Analysis, 2nd Ed., New York: Harper and Row".
- Yirda, A., Eshetu, M., & Babege, K. (2020). Current status of camel dairy processing and technologies: a review. *Open Journal of Animal Sciences*, 10(3), 362-377.
- Yosef, T., Mengistu, U., Solomon, A., Mohammed, Y. K., & Kefelegn, K. (2013). Camel and cattle population dynamics and livelihood diversification as a response to climate change in pastoral areas of Ethiopia. *Livestock Research for rural development*, 25(9), 1-10.

Notes

Annex of tables and figures

Table 1: The demographic characteristics of respondents

Variables	The proportion of respondents in tribes				Overall	P-Value
	Borana	Gabra	Dogodi	Guji		
Sex (%)						
Male	93.6	81.9	100.0	100.0	89.6	0.01
Female	6.4	18.1	0	0	10.4	
Marital status (%)						
Single	3.5	2.7	0	0	2.7	0.001
Married	96.5	68.5	100.0	100.0	85.4	
Divorced	0	14.1	0	0	5.8	
Widowed	0	14.8	0	0	6.0	
Educational status (%)						
Never attended	95.4	88.6	89.5	75.0	91.8	
Non-formal	4.6	10.7	10.5	25.0	8.0	0.267
Secondary	0	0.7	0	0	0.3	
Age categories (%)						
18-30	12.1	5.4	15.8	0	9.6	
31-45	34.7	29.5	47.4	25.0	33.8	0.030
46 and above	53.2	65.1	36.8	75.0	56.6	
Family size (mean SD)	4.49±2.467	7.90±3.642	5.24±2.059	8.50±4.509	6.53±3.169	
Religions						
Muslim	3.5	98.7	84.2	0.0	50.8	
Waqefata	90.2	1.3	15.8	25.0	45.3	
Protestant	6.4	0.0	0.0	75.0	3.8	

Table 2: Income sources of respondents with tribe affiliations

Sources of incomes	Response	The proportion of respondent's tribe's group's				Overall
		Borana	Gabra	Dogodia	Guji	
Animal rearing	Yes	100.0	81.9	100.0	100.0	92.6
	No	0.0	18.1	0.0	0.0	7.4
Crop Cultivation	Yes	93.1	80.5	97.4	100.0	88.5
	No	6.9	19.5	2.6	0.0	11.5
Livestock trade	Yes	20.8	68.5	21.1	50.0	40.7
	No	79.2	31.5	78.9	50.0	59.3
Causal labor	Yes	6.9	22.1	13.2	0.0	13.7
	No	93.1	77.9	86.8	100.0	86.3
Rental house in town	Yes	3.5	22.1	5.3	0.0	11.3
	No	96.5	77.9	94.7	100.0	88.7
Petty trade	Yes	11.0	10.1	13.2	0.0	11.0
	No	89.0	89.3	86.8	100.0	89.0
Sale of forest product	Yes	1.2	11.4	2.6	0.0	5.5
	No	98.8	88.6	97.4	100.0	94.5

Table 3: Percentages of tribe's affiliations as Sources of starting camel

Sources of starting camel	The proportion of respondents' tribe groups				Overall
	Borana	Gabra	Dogodia	Guji	
Inherited	34.1	71.1	34.2	0.0	48.9
Purchased	52.0	18.8	52.6	50.0	38.5
Gift	12.7	10.1	10.5	0.0	11.3
Others	1.2	0.0	2.6	50.0	1.4

Table 4: Percentages of tribe's affiliations and years of camel keeping experience.

Years of keeping experience	The proportion of respondents' tribe groups				Overall
	Borana	Gabra	Dogodia	Guji	
1-5 years	5.2	10.1	0.0	0.0	6.6
6-10 years	7.5	4.0	15.8	0.0	6.9
11-20 years	17.3	17.4	13.2	50.0	17.3
More than 21 years	69.9	68.5	71.1	50.0	69.2

Table 5: Percentages distributions and Chi-square test of respondent's reasons for keeping camels (%)

Variables	Responses	The proportion of respondent's tribe groups				Overall	P-value
		Borana	Gabra	Dogodia	Guji		
DR	Yes	56.1	75.8	76.3	50.0	66.2	0.001
	No	43.9	24.2	23.7	50.0	33.8	
SP	Yes	93.6	85.9	94.7	100.0	90.7	0.073
	No	6.4	14.1	5.3	0.0	9.3	
MP	Yes	57.8	87.2	60.5	50.0	70.1	0.000
	No	42.2	12.8	39.5	50.0	29.9	
GKC	Yes	28.9	61.1	44.7	25.0	43.7	0.000
	No	71.1	38.9	55.3	75.0	56.3	
CV	Yes	67.1	89.3	71.1	100.0	76.9	0.000
	No	32.9	10.7	28.9	0.0	23.1	

DR= Drought resistant; SP= Social Prestige; MP= Milk production; GKC= Grows up knowing camel; CV= Commercial value.

Table 6: Herd structure percentages distributions and Chi-square test of respondent's

Herd structure	The proportion of respondents' tribe groups				Overall	P-value
	Borana	Gabra	Dogodia	Guji		
Herd size in categories (%)						
< 10 heads	87.9	88.6	78.9	50.0	86.8	0.115
11-20 heads	10.4	10.7	21.1	50.0	12.1	
>21 heads	1.7	0.7	0.0	0.0	1.1	
Number of she-camel in herds (%)						
< 10 heads	87.9	87.2	76.3	50.0	86.0	0.051
11- 20 heads	9.8	12.1	23.7	50.0	12.6	
> 21 heads	2.3	0.7	0.0	0.0	1.4	
Number of breeding males in herds (%)						
None	56.6	13.4	52.6	0.0	37.9	0.000
1 head	26.0	14.8	26.3	25.0	21.4	
2 heads	13.3	54.4	10.5	25.0	29.9	
> 3 heads	4.0	17.4	10.5	50.0	10.7	

Table 7: Production system and settlement practices among herders in the study areas (%)

Production patterns	The proportion of respondents' tribe groups				Overall
	Borana	Gabra	Dogodia	Guji	
Sedentary settlement	83.2	69.8	78.9	75.0	77.2
Seasonal Mobility	3.5	14.1	0.0	0.0	7.4
Herd splitting	13.3	16.1	21.1	25.0	15.4

Table 8: Herd Management and family roles among clan affiliations in the study areas (%)

Family members	The proportion of respondent's herders' tribe groups				Overall
	Borana	Gabra	Dogodia	Guji	
Husband	39.7	42.8	43.1	25.0	41.3
Wife	32.2	26.0	23.5	25.0	28.7
Children's	25.9	27.9	29.4	50.0	27.3
Relatives	2.1	3.3	3.9	0.0%	2.8

Table 9: feed resources available in the study areas

Production Parameters		The proportion of respondent's districts			Overall
		Yabello	Elwaye	Gomole	
Feed available in the wet season	Communal land	71.0	61.8	55.4	60.8
	Roadside	15.3	24.2	35.1	27.3
	Cropland	1.5	2.4	4.1	3.0
	Private Kalo	6.1	5.5	0.0	3.0
	Communal Kalo	6.1	6.1	5.5	5.8
Dry season feed is available	Communal land	22.3	21.0	1.4	13.6
	Roadside	26.9	29.4	4.0	18.5
	Cropland	25.1	22.0	24.9	24.1
	Private Kalo	5.6	6.5	34.4	17.4
	Communal Kalo	20.1	21.0	35.2	26.4

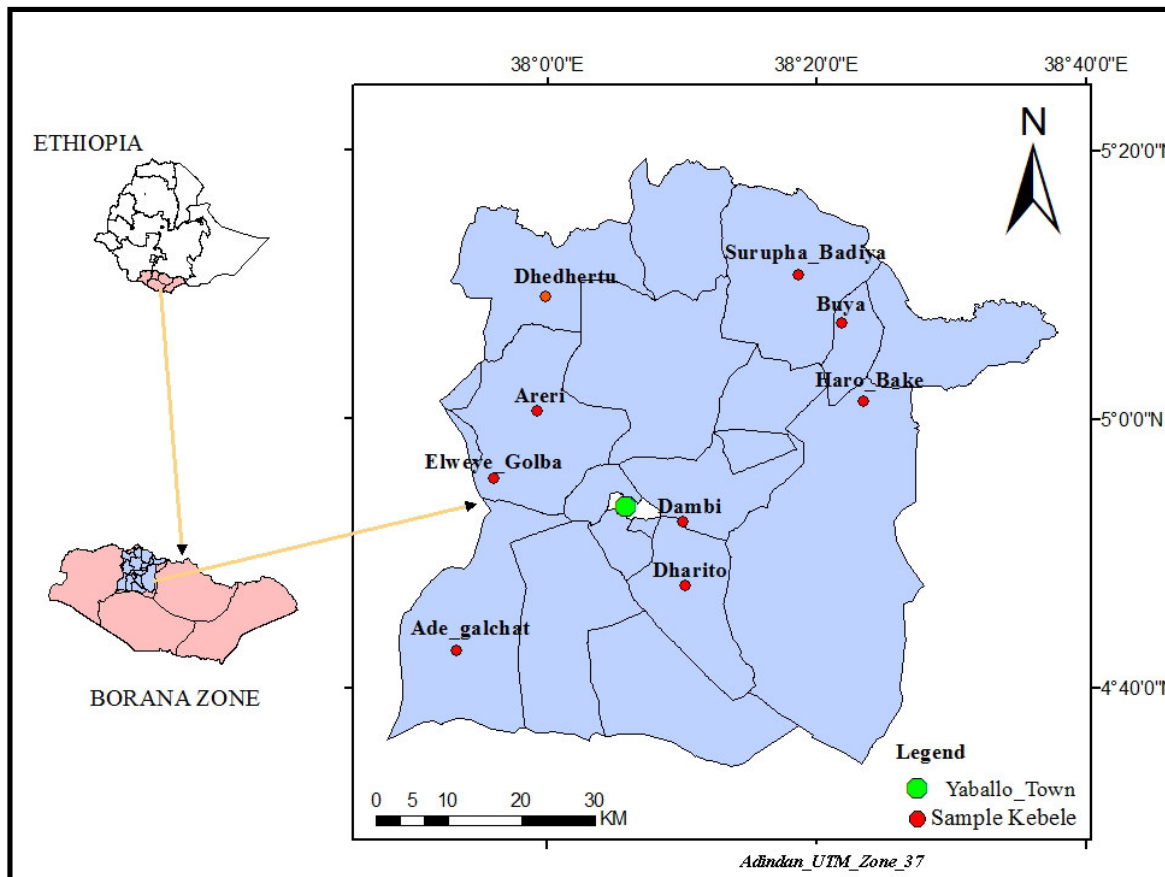


Figure 1 Map showing study kebeles of (Yabelo, Elweye, and Gomole) districts.

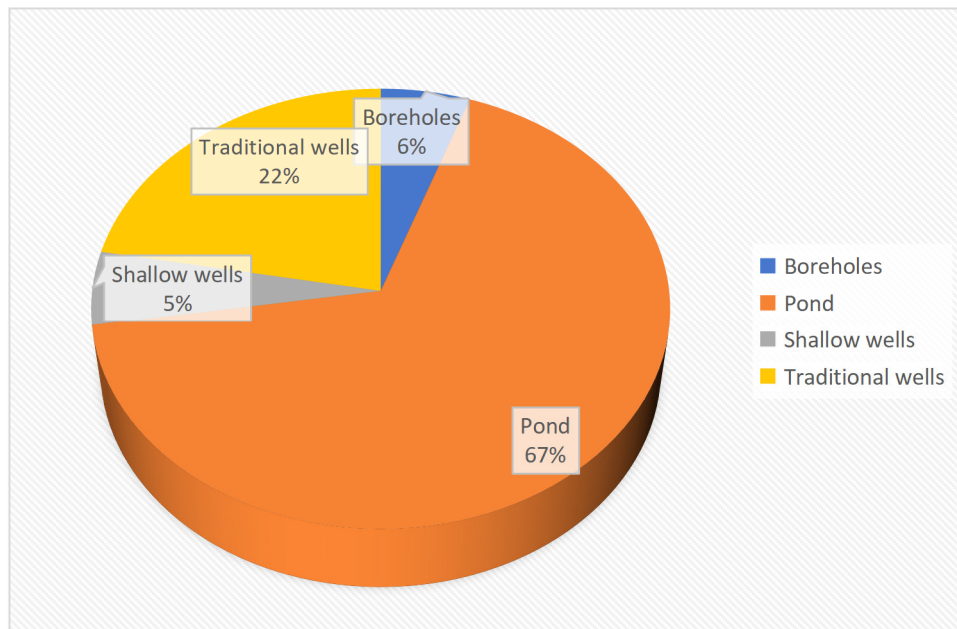


Figure 2 The Water sources for camels in the study areas