

Review

Potential of camel production and management Practices in Ethiopia: Review

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The camel is one of the most vital domestic animals species for pastoralist livelihood as much as their blood circulation. The annual camel milk production of Ethiopia in 2018 is estimated to be 176113 tones. Camel produces considerable amount of milk and for long period of time than other milk producing animals under harsh conditions. Meat quality is largely age dependent and as other animals, good meat is from young slaughtered camel. Camel herd sizes per household vary from few heads to several hundreds. The proportion of male to female animals in breeding herd is not equal because of higher number of female camels in the herd as compared to male camels. During the dry season all female camels are shifted to areas with better feed accessibility but male camels are usually reared around settlement area. Mostly male camels are used for transportation of commodities. Breeding management comprises of selection of best animals for next generation and/or culling of the worst animals from the herd, and controlled breeding. Camels start breeding at the end of the dry season and the beginning of rainy season and continue through the season. Camel can be categorized under seasonal breeding animal species. Prevalence of disease in pastoral areas of Ethiopia is principal constraint of the pastoralist in their camel production. There are inadequate researches and reports have been conducted on potential of camel production and management system in the country. Therefore, this review paper is going to present potential of camel production and management practices in Ethiopia.

Key words: Camel, management practices, production potential.

INTRODUCTION

Camel (*Camelus dromedaries*), the most climate resilient livestock, plays a significant role in the livelihood of pastoral and agro-pastoral communities in Ethiopia (Alemnesh et al., 2020). 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 (Mwinyikione et al., 2016). Areas of camel rearing are expanding partly due to changes in climate especially in Africa (Faye et al., 2012). Camels (*C. dromedaries*) are very important domestic animals species uniquely adapted to arid and semiarid

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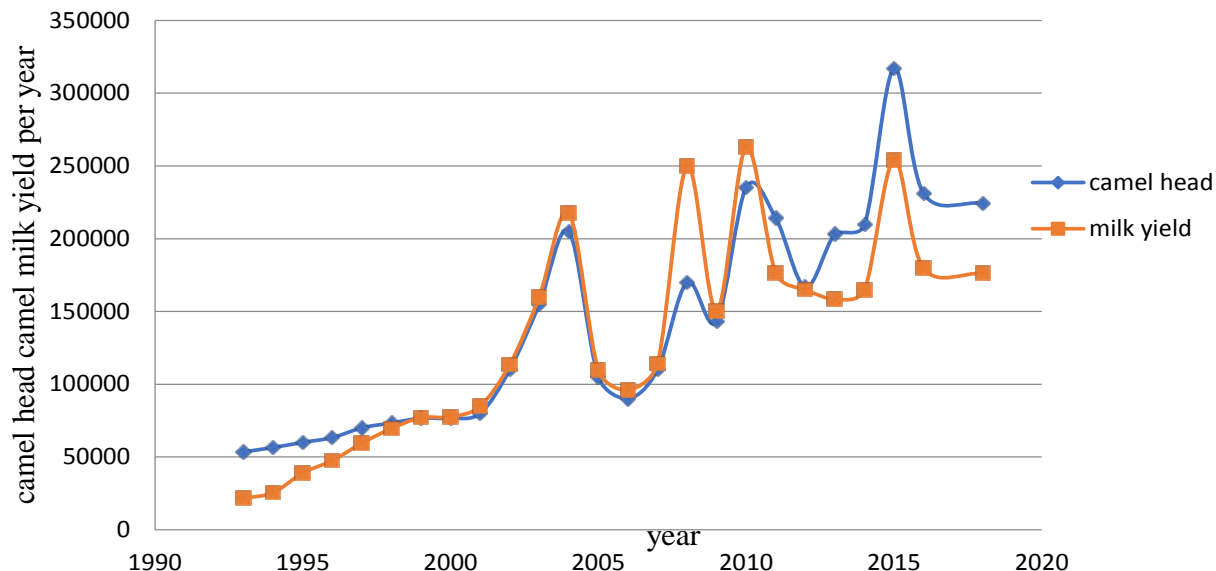


Figure 1. Camel population and camel milk production per year. FAO (2018) camel population (<http://www.fao.org/corp/statistics/en/>); FAO (2018) camel whole fresh milk (<http://www.fao.org/corp/statistics/en/>).

zones in Asia and Africa (Faraz, 2020). In Ethiopia, 1.42 million heads of dromedary camels are reared in arid and semi-arid regions (CSA, 2018) 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., 2014a; Tura et al., 2010; Abbas et al., 2000, Faraz et al., 2019a; Faraz, 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 (Ahmad et al., 2010; Yosef et al., 2014b; Faraz et al., 2019b), are used as pack animals for transport, hides and wool are products that emanate from camels (Aujla et al., 2013; Faye et al., 2010; Mwinyikione et al., 2016; Faraz et al., 2019c). 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., 2021a).

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., 2014b; Yohannes et al., 2015). The unfair distribution of responsibility and gender inequality is seen in camel management practice. The management is exclusively the responsibility of men and son in the pastoral areas of Ethiopia with very little participation of women (Simenew et al., 2013). Women

are not allowed herding camels since it is a difficult duty and camels browse until night time, if women keep camels which will cause a risk (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 (Yohannes 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. Therefore, the objective of this review paper is to assess the potential of camel production and management practices in Ethiopia.

POTENTIAL OF CAMEL PRODUCTION

Potential of camel milk production

Camel milk comprises different products like whole milk, cheese, butter and ghee. In pastoral areas of Ethiopia, camel milk is utilized in the form of whole milk. Camel milk is essential diets for family in an area that may correctly term as arid and semi-arid areas. The annual camel milk production in Ethiopia is estimated to be 176113 tones (FAO, 2018) (Figure 1). Data on the actual amount of milk produced by camel is not exact for juggling the milk yielding potential in Ethiopian. Average daily milk production estimates for Somalia camel ranges from 1-12

Table 1. Estimate of milk production potential of camels.

Parameter	Estimated	Location	Sources
Milk yield liters/day	5.2(1-10)	Shinile and Jijiga,Somalia	Eyasu (2009)
	4.8	Babile and Gursum, Somali	Bedilu et al. (2017)
	3.2-6.41	Babile,Somali	Yohannes et al. (2007)
	3.19-5.73	Kebribeyah,Somalia	Yohannes et al. (2007)
	7(2-12)	Afar	Simenew et al. (2013)
	2.4	Mieso, Oromia	Kedija et al. (2008)
	10.5(5.55-11.4)	Haramaya university, Easter Ethiopia	Moges et al. (2016)
	3.43	Aysaita, Afar	Shishay and Mulugeta (2018)
	4(3-5)	Jijiga,Somalia	Sisay et al. (2015)
	1-6	Jijiga, Somalia	Mahamed et al. (2015)
	3.75	Erer valley, east Hararghe	Mekuriaw (2007)
	6	Borana, Southern Ethiopia	Megersa et al. (2008)
	Lactation lengths per months	12	Babile andKebribeyah, Somali
12		Afar	Simenew et al. (2013)
10		Babile and Gursum, Somali	Bedilu et al. (2017)
13.87		Babile, Somali	Sisay et al. (2015)
12.56		Gursum, Somali	Sisay et al. (2015)
11.25		Mieso, Oromia	Kedija et al. (2008)
13.8(9-16)		Aysaita, Afar	Shishay and Mulugeta (2018)
Milking frequency	12.7(6-24)	Shinile and Jijiga,Somalia	Eyasu (2009)
	13.76	Afar and Somalia	Yosef et al. (2014b)
	2-4	Shinile and Jijiga,Somalia	Eyasu (2009)
	1-5	Babile and Gursum, Somali	Sisay et al. (2015)
	2-3	Afar	Solomon et al. (2017)
	2-3	Mieso Oromia	Kedija et al. (2008)
	2-3	Jijiga, Somalia	Mahamed et al. (2015)
2-5	Aysaita, Afar	Shishay and Mulugeta (2018)	
2-3	Afar	Simenew et al. (2013)	

kg of milk. Whereas daily milk yields for afar camel is between 2-12 kg. Estimates of average daily milk yield of camels in different regions of Ethiopia range between 1 and 12 (Table 1). Different study reports indicate that camel milk yield greatly vary from place to place and region to region. The variation in production mainly depends on the breed of camel, its age, lactation length, seasonal fluctuation and availability of feed and water (Farah et al., 2004). Daily yield of camel milk may vary with seasonal fluctuation and production system applied in area. The highest milk yield is obtained during rainy season regardless of production system (Tekle and Tesfaye, 2013). This might be due to nutritional status of the feed during the wet season, where feeds are an abundance of many types of vegetation and rich in nutrients (Hamed et al., 2017). The camel produced adequate amount of milk during supplementary feed consumption (Moges et al., 2016). Milk yield is affected by stage of lactation length and production system. The yield of milk decreases when the phase of lactation grows longer. The highest milk yield is obtained from camels at first three months of lactation and lower milk yield is

found at late lactation (Wafa and Ibtisam, 2014).Yohaness et al. (2007) indicates that better milk yield for early and mid-stage of lactation than late stage of lactation. Higher daily milk is gained for camels in late stage of lactation kept under pastoral production system compared to their contemporaries kept under agro-pastoral management (Tekle and Tesfaye, 2013). Bakheit et al. (2008) described that camel kept under semi-intensive management were able to produce better milk than kept under traditional system.

Lactation lengths in different studies of Ethiopian camels vary widely. Lactation length shortened when producers have plenty of feed for the calf. Lactation length extended to prevent pregnancy and then to carry on to continue milk production for household consumption as well as to safeguard the camel calf (Yohannes et al., 2007) and if extent of demand for milk by the owner advanced than ever and there is better feed availability for the animal (Simenew et al., 2013). Camel milking frequency may vary from pastoralist to pastoralist and it mainly depends on quality of milk produced per camel, pastoralist demand for milk, season and amount

Table 2. Camel population and camel production.

Country	Camel population	Camel milk production	Years
Ethiopia	224251	176113	2018
Kenya	1227873	854669	2018
Libya	10970	2225	2018
Niger	235481	105967	2018
Somalia	2399259	958079	2018
Sudan	1708000	61000	2018
Tunisia	3624	1093	2018

FAO (2018) camel population (<http://www.fao.org/corp/statistics/en/>)

FAO (2018) camel whole fresh milk (<http://www.fao.org/corp/statistics/en/>)

Table 3. Camel population and camel meat production in Ethiopia.

Country	Camel population	Camel meat production	Years
Ethiopia	29000	5000 ^F	1993
	47000 ^{IM}	8000 ^F	1996
	59000 ^{IM}	10000 ^F	1999
	79000 ^{IM}	13430 ^F	2002
	78000 ^{IM}	13260 ^F	2005
	170000 ^{IM}	28900 ^F	2008
	16500 ^{IM}	28050 ^F	2011
	14000 ^{IM}	28050 ^F	2014
	14000 ^{IM}	28050 ^F	2016
	147251	29125 ^{IM}	2018

FAO (2018) camel population (<http://www.fao.org/corp/statistics/en/>)

FAO (2018) camel whole fresh milk (<http://www.fao.org/corp/statistics/en/>)

of milking camel present in the herd, availability of alternative food for the camel owner, age of animal and health of calves.

The trend of camel milk yield and camel head in Ethiopia from 1993-2018 shows there is inconstancy milk production and camel population per year. Milk yield and camel population gradual increase from 1993-2000 and they show sharp increment from 2000-2004 and sharp decrement 2005-2006. Wako et al. (2017) confirmed that the impacts of climate change in 2005 and 2006 in relation of frequent drought occurrences change in status of natural resources, and change in the ecology of vegetations dynamics and composition in rangeland, disease occurrences in Ethiopia. Similarly in 2018 milk production decreased 1.97% as compared with 2016. The fluctuation in milk production attributed by frequent drought occurrences in a year and lack of adequate feed accesses.

With 176113 tons of milk in 2018, Ethiopia was third among other countries in camel milk production. The country is overtaken by Somalia and Kenya which were number one and two with 958,079 and 854,669 and is followed by Niger and Sudan at 105,967 and 61,000. Somalia leads the ranking with 958,079 tons in 2018, a

growth of 0.25 compared to 2016. Tunisia produces the lowest milk as compared to Somalia, Kenya and Ethiopia.

Potential of camel meat production

The estimate of camel meat production represents about 1.91% of Ethiopia meat production (CSA, 2017) but information is quite difficult to collect as main part of the camel meat data comes from the informal market. The total meat consumption indicates an uptrend owing to increasing income and population (AACCSA, 2015). The increase in number of camels slaughtered at Dire Dawa abattoir in 2015 by 63.54% compared to 2014 slaughtered may also be due to the supply of more camels to local market that increased the slaughter volume of the abattoir. The increase trend in camel meat consumption of 78288 kg in 2012 to 230763 in 2015 and the increase in meat consumers linked to an increase in human population (Mohammed et al., 2017) (Tables 2 and 3).

Meat production potential varied from production system, age, sex and body weight of animals (Faraz et al., 2018). Difference body weight might explain the

variation in meat production potential (Tekle and Tesfaye, 2013). In the camel herd, sources of meat include young/old males and unproductive female. The camels slaughtered at the abattoir are approximately at fully developed age categories (Mitiku and Getachew, 2015). The camels slaughtered in the Jijiga and Dire Dawa abattoir varied from age and body condition. Young camels' meat highly preferred because of its leanness, tenderness, juiciness fast cooking (Kadim et al., 2014; Mohammed et al., 2017). Quality of meat from young camels known to be comparable to beef (Mahgoub and Kadim, 2012). The age and body conditions of camel had a significant effect on the proportion of carcass components. Camels aged 6-10 years produce a higher proportion of muscle and bone than camels aged greater than 11 years but camels aged over 18 year produce better amount of fat. Higher proportions of muscle and bone got from deprived camels and medium body condition groups than camels with a good body condition group (Ali et al., 2017). Meat production potential varied from production system to production system. Camels in agro-pastoral system have improved meat production potential than in pastoral production system (Tekle and Tesfaye, 2013). Meat production associated with right herd management in terms of choice animals to be slaughtered (Mohammed et al., 2017). According to Melkamu and Fesseha (2001), nearly 90% of male camels slaughtered from eastern Ethiopia and rest are unproductive females. Camels produced high carcass yield (Mohammed et al., 2017). The meat yield of the camel and its taste determined by different factors like; age, sex, feeding condition and general health of the animal. Sex has a significant influence over dressing percentage, males are having dressing percentage than female (Abebe et al., 2002).

Mostly camel-producing communities' livelihood attached to a camel, and never slaughtered a camel for home consumption of meat unless compelled by circumstances (Farah et al., 2004). Pastoralist consume camel meat during festive and cultural obligation such as person died from family members and accidental injured but they consume when they available (Yohannes et al., 2007; Eyasu, 2009; Mohammed et al., 2017). Moreover, meat from camel is the main source mostly in areas where the climate adversely affects the performance of other meat from other animal species (Kurtu, 2004).

Camel meat is one of the least studied type of meat and believed to be lower nutritive value (Abdelhadi et al., 2013). The overall preference to meat types showed camel meat ranked first and more preferred to chevon in Shinile district but opposite was the case in Dire Dawa. In terms of meat attributes, camel meat is the least preferred for tenderness but it has got better preference for flavor and juiciness (Mohammed et al., 2017). Camel meat preserved for prolonged period maintaining of shelf life by using the traditional method of meat preservation. More than half of the respondents in Babile showed they

can maintain the shelf life of the meat as long as five years (Yohannes et al., 2007).

Draught power

Camels expend between 17 to 22% of body weight for draft power (Patil and Gupta, 2012). Typically, male camels used for packing animals. Transport of people, goods and mobile houses of the pastoralists during their seasonal migration in explore of feed and water for their animals is an important contribution rendered by dromedary camels (Yohannes et al., 2007; Eyasu, 2009). Yacob and Andy (2011) reported that, afar and Issa camels can meet the physical strength necessary to carriage salt block from Berahle to the uplands. In view of lack of roads and transportation facilities and the inaccessible terrain in most pastoral areas, the role of the camel as a pack animal is crucial and determines the survival of the nomads in the hostile environments of the desert. The pastoralist often considers camel as "ship of desert" in Somalia regional state (Eyasu, 2009). According to Yohannes et al. (2007) camel can plough 0.5 ha of land per day and it shows camel has greater power for ploughing a land.

Camel management practices

It could broadly classify the camel's husbandry in different parts world as traditional nomadic management system and transhumant, sedentary, semi-intensive and intensive management system (Faraz et al., 2021b). In Ethiopia semi-intensive and intensive management practice not practiced for camel production as compared to other animals. There is no improvement in housing, feeding and watering to advance production system. Management practice in Ethiopia is basically traditional and they house camels in open camp around their home during night and herded during day time in communal grazing land (Shishay and Mulugeta, 2018). Yohannes et al. (2015) revealed that camels reared under an extensive management system are browse and graze together with other species of animals. Pastoralists managed young animals in the traditional way (Awoke et al., 2015). Husbands and sons are responsible members of the families to manage camels in the Afar society (Simenew et al., 2013; Yohannes et al., 2015). The management by female members of the families includes gathering cut-and carry forages and hauling water for relatively immobile young calves, which are kept in near the family hut (Awoke et al., 2015). Proper management has significant roles in the long-term improvement of camel reproduction and productivity (Fazal et al., 2017).

Camel holding

It indicates an average number of camels' population per

Table 4. Estimate of meat production potential of camels.

Parameter	Estimated		Location	Sources
	Male	Female		
Dressing percentage	54.03±5.13	50.65±3.70	Jijiga and Harar	Kurtu (2004)
	47.2-62.8(55)	-	Ogaden Somali	Moges et al. (2016)
	53.7±5.68	48.3±4.7	Dire Dawa Eastern Ethiopia	Abebe et al., (2002)
	55.5	-	Shinile and Dire Dawa Eastern Ethiopia	Mohammed et al. (2017)
	54.03	50.65	Eastern Ethiopia	Mitiku (2012)
Carcass yield	235	191.37	Babile andKebribeyah Somali	Yohannes et al. (2007)
		186.4	Shinile and Dire Dawa Eastern Ethiopia	Mohammed et al. (2017)
	144.6	-	Ogaden Somali	Moges et al. (2016)
	237.3±39.6	210.7±31.6	Dire Dawa Eastern Ethiopia	Abebe et al. (2002)
Off take		3.7	Borana, Southern Ethiopia	Megersa et al. (2008)

Table 5. Average camel herd size per household in major camel keeping society.

Location	Camel holding per household	Sources
Jijiga and Shinelle, Somalia	25.7(1-150)	Eyasu (2009)
Jijiga, Somalia	20.4(4-40)	Yosef et al. (2014b)
Shinelle, Somalia	20.2(2-35)	Yosef et al. (2014b)
Babile, Somalia	34.5(16-66)	Sisay et al. (2015)
Gursum, Somalia	28.5(16-51)	Sisay et al. (2015)
Amibara, Afar	19.2 (4-50)	Yosef et al. (2014b)
Mille, Afar	28.1(8-53)	Yosef et al. (2014b)
Gode, Somalia	27.5(6-52)	Yosef et al. (2014b)
Aysaita, Afar	26.9	Shishay and Mulugeta (2018)
Moyale, Somalia	24.1(8-50)	Yosef et al. (2014b)

house (Table 3). Difference existed among different camel-keeping societies in Ethiopia in the number of camel owned per household. There seems inconsistency according reported results on trend of camel herd size per households. Decreasing of camel population per household have seen in Ethiopia in 2014 as compared to 2011 (FAO, 2018) and they may be attributed to inconsistency in sample size of study, scarcity of feed and impact of climate change. Among the total number of camels owned by a household, the number of female camels far exceeds that of male camels (Eyasu, 2009; Dejene, 2017; Shishay and Mulugeta, 2018). They mainly used male camels as a pack animal. According to Simenew et al. (2013) found the ratio of male to female in breeding herd to be 1:30 but might be going up to 1:50, where the male is in his peak rutting vigor and in a good season of the year. From total camel herd size female and calves contributes 78-83%. The preference for more female than male is to ensure good supply of milk and reproductive potential. The primary reason for pastoralists owning a greater number of females in the herd is to ensure year-long milk production irrespective of

season and to guarantee a stable recovery and continuity of camel in the community (Yosef et al., 2014b) (Tables 4 and 5).

Feeding system

Individual stock ownership, communal use of open areas and seasonal migration of herds and households characterizes traditional pastoral livestock production in Ethiopia. Camel can consume poor nutritional value plant that other animal species refuse. Camels in Jijiga and Shinile areas feed only on unimproved perennial natural vegetation of low nutritive value and they are not given supplementary feed (Eyasu, 2009). Similarly, majority of Asayita and Awash pastoralist do not grow fodder and depend on native browses and have no time to grow fodder since they practice nomadism (Solomon et al., 2017). Mille and Amibara districts reared male camels separately except during breeding season while in Shinille, both sexes reared and browse together except during dry season. During the dry season both female

and male camels are not feed together, female camel shift to areas of better feed availability and male camel kept around settlement area for transportation goods (Yosef et al., 2014b). The main camels feed are trees or bushes, but they also graze grasses when browsing tree are not available. Camels optionally utilized wet season herb and grass since they are least preferred compared with browse trees and shrubs (Yohannes et al., 2015; Aklilu et al., 2019). In Raya Azebo districts the majority of camels reared on range lands moving from one place to another without limitations and minority fed on purchased feed (Yohannes et al., 2015). Afar pastoral people migrate mostly in the dry season to search for pasture, water and to prevent their animals from diseases occurring during those dry seasons in the area. Very rare migration occurred during the rainy season to high land areas because of the Awash River flooding problem (Simenew et al., 2013). Besides to selective feeding characteristics of camel, the use of feeds like herbaceous and grass as camel feed is not exercised yet (Aklilu et al., 2019).

Breeding practice

Various camel population exist in Ethiopia, they possess different trait of interest for which they preferred from the pastoralists for breeding objectives are too scant. Some of the studies indicated the breeding objectives of pastoralist in Afar and Somalia community highly consider milk production as trait of preference followed adaptability, breeding efficiency, growth, ability to give birth to more female and draught capacity (Yosef et al., 2014b) and proportion of male camels they rear in the herd (Megersa et al., 2008). Pastoralists selects bulls at different age groups, selection of the bull is applied at maturity in afar except Shinille and early communities. In Afar community selection of breeding bull is practiced from their own herds because male family member inherits every camel husbandry practice from their ancestors and they try to maintain the previous breeding practices (Kurtu, 2004). Breeding bulls are culled from breeding at an average age of 16±4years in Jijiga zone of Somalia region. Male camels not selected for breeding purpose are culled by selling or castration, assigning it baggage duties and complete separation from the female herd (Simenew et al., 2013; Awoke et al., 2015). The culling practice used by pastoralist varies from districts to district. Pastoralist in Jijiga and Babile districts cull bull from their herd by doing castration while Gursum district sold out the male or converted them into baggage animals (Awoke et al., 2015). Castration of male camels is one of culling method practiced by pastoralists in some part of Somalia regional state because of the demand for large size and good meat formation for export market than other breeds in region. Pastoralists castrate camels to prevent unwanted mating with poor performing males

and inbreeding of camels. Although the major aim of castration is to prevent breeding by inferior male, it also helps ease of handling and better fattening for sale (Yosef et al., 2014b). Camel breeding starts at the beginning of the rainy seasons (main and short) and continues throughout the season (Simenew et al., 2013). In domestic breeding herds, usually one male is kept for many females. There is a strict hierarchical dominance relationship between males, established by competition during the mating season (Simenew et al., 2013; Awoke et al., 2015). In afar area majority of breeding herd, usually one male is kept for many female and also, almost all pastoralists in Shinille and majority of Jijiga and Moyale districts keep 2-4 breeding male camels in the herd (Yosef et al., 2014b).

Health management

Health management is critical in controlling mortality and improves production, productivity of camel. In comparison, camels have the potential to resist many diseases than other livestock species. However, still camels are susceptible to wide range of disease for which the main cause is infection with pathogenic viruses or bacteria, infestation with parasites (Jabir et al., 2017). Disease incidence is also reported as principal constraint of camel production in the pastoralist areas of Ethiopia (Simenew et al., 2013; Yosef et al., 2014b; Awoke et al., 2015; Yohannes et al., 2015; Dejene, 2017). Similarly, high incidence of parasitic as well as infectious diseases in camel herds is reported as serious concern. In addition to disease problem for the pastoralist, lack veterinary services, lack of governmental or private drug store and lack of professional support toward improvement of production and productivity of their camel (Simenew et al., 2013; Dejene, 2017). Repeated improper application of antibiotic treatment is highly practiced by the pastoralists themselves for any type of health problems of all their livestock species and this might lead to drug resistance to the common antibiotics (Simenew et al., 2013). Disease is the main factor influencing camel milk production in pastoral areas of afar (Solomon, 2017).

Housing system

Mostly camel housing system in Ethiopia categorized as in to two main classes; named as open and closed housing system, which are mainly depends on; age category of the animals, living environment, locally available materials, settlement of the owners, exposure to predators and so forth. Mature camels are housed in the fence around their home during night and herded during day time on communal grazing lands and also, camel calves are housed in (Gesso) local name of enclosure made for the purpose of keeping calves separately from

rest of the herd, Gesso is constructed with wood (*keselto*) and fencing by available piece of thorn wood (*Prosopis juliflora*) and different bush plants in and around north-east parts of Ethiopia (Shishay and Mulugeta, 2018). Almost all the camel breeders kept their animals in traditional *kraal* made up of thorny bushes to protect the animals from some predator in Southern parts of Ethiopia (Dejene, 2017).

CONCLUSION AND RECOMMENDATION

The type of camel that existed in Ethiopia is camel dromedaries (one humped camels). The majority of camels in the country are found in the dry areas of the eastern part of the country that is, Afar region, Somalia region and eastern part of Oromia region. Camel production is highly associated with the availability and quality feed resource in all seasons. The production is mainly for subsistence but surplus animals are sold. They are exclusively produced under traditional system on poor levels of nutrition and mostly slaughtered at older age after career in work or milk production. The camels slaughtered in the abattoir and backyards are heterogeneous in age and body condition. The rate and level of camel milk production potential determine by species, breed, feed, environment and many other management practices. Pastoral camel production has the potential of yielding positive impact on socioeconomic, environmental and gender related aspects. Pastoralists have been rearing different camel herd structures whose proportions vary from categories to other. Among the total number of camels housed, female camels have numerical dominance over male camels. Selection and culling of female camel is not done in all pastoral community. The feed and water scarcity, prevalence of disease and housing are main constraints of camel production and productivity in pastoral areas of the country. Therefore, further research and investigations should be conducted to identify and alleviate existing constraints related with camel production and management practices; stakeholders must have made clear intervention by designing different strategies and techniques to modernize camel production and management practices in the country.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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REFERENCES

- AACCSA (Addis Ababa Chamber of commerce and Sector Association) 2015. Value chain study on meat processing industry in Ethiopia. BCaD consulting plc, Addis Ababa, Ethiopia. Retrieved from <http://mau.addischamber.com/pdf/Business-Opportunity-for-meat-processing-VC.pdf>
- Abbas B, Al Qarawi AA, Al Hawas A (2000). Survey of camel husbandry in Qassim Region, Saudi Arabia: Herding strategies, productivity and mortality. *Revue D Elevage Et De Medicine Veterinaire Des Pays Tropicaux* 53(3):293-298.
- Abdelhadi OMA, Babiker SA, Hocquette JF, Picard B, Durand D, Faye B (2013). Effect of ageing on meat quality of the one humped camel (*Camelus dromedarius*). *Emirates Journal of Food and Agriculture* 25(2):150-158.
- Abebe W, Getinet AM, Mekonnen HM (2002). Study on live weight, carcass weight dressing percentage of Issa camel in Ethiopia. *Revue de Médecine Vétérinaire* 153(11):113-716.
- Ahmad S, Yaqoob M, Hashmi N, Ahmad S, Zaman MA, Tariq M (2010). Economic importance of camel: unique alternative under crisis. *Pakistan Veterinary Journal* 30(4):191-197.
- Aklilu B, Madalcho B, Abera T, Keyalew G, Gebremedhin G (2019). Camel Feed Characterization of Ethiopian Somali Region Rangelands through Traditional Knowledge. *Journal of Agriculture and Ecology Research International* 19(3):1-15.
- Alemnesh Y, Mitiku E, Kibebew B (2020). Current Status of Camel Dairy Processing and Technologies: A Review. *Open Journal of Animal Sciences* 10:362-377.
- Ali S, Mohammed Y, Mengistu U (2017). Slaughter practices and composition of dromedary camel (*Camelus dromedarius*) meat in relation to age and body condition in Eastern Ethiopia. *Journal of Agriculture and Environment for International Development* 11(1):191-206.
- Aujla KM, Rafiq M, Hussain A (2013). The marketing system of live-camels and camel products in the desert ecologies of Pakistan. *Pakistan Journal of Agricultural Research* 26(2):130-142.
- Awoke K, Seid MA, Mohamed H (2015). Assessment of Challenges and Opportunities of Traditional Camel Calf Management Practices in Fafen zone, Somali Regional state, Ethiopia. *International Journal of Current Science and Technology* 3(6):20-27.
- Bakheit SA, Majid AM, Abu-Nikhila AM (2008). Camels (*Camelus dromedarius*) under pastoral systems in North Kordofan, Sudan: Seasonal and parity effects on milk composition. *Journal Camelid Science* 1:32-36.
- Bedilu D, Hussien HK, Adem K (2017). Production and marketing of camel milk in eastern Africa. *African Journal of Marketing Management* 9(7):98-106.
- CSA (Central Statistic Authority) (2018). Ethiopia agricultural sample survey. Report on livestock and livestock characteristics (private peasant holdings) Bulletin, 587 Volume II. Addis Ababa, Ethiopia, 100p.
- Dejene TG (2017). Husbandry Practices and Utilization of Camel Products in Borana Zone of Southern Oromia, Ethiopia. *Science Research* 3(4):191-197. doi.org/10.17582/journal.pjz/20200227090212
- Eyasu S (2009). Analysis on the contributions of and constraints to camel production in Shinile and Jijiga zones, eastern Ethiopia. *Journal of Agriculture and Environment for International Development* 103(3):213-224.
- FAO (2018) camel population and <http://www.fao.org/corp/statistics/en/>
- FAO (2019). R. Italy. FAOSTAT
- Farah KO, DM Nyariki, RK, Ngugi, IM Noor, Guliye AY (2004). The Somali and the Camel: Ecology, Management and Economics. *Anthropologist* 6(1):45-55.
- Faraz A (2020). Food security and socio-economic uplift of camel herders in Southern Punjab, Pakistan. *Land Science* 2(2):8-11. <https://doi.org/10.30560/ls.v2n2p8>
- Faraz A (2021). Blood biochemical and hair mineral profile of camel calves reared under different management systems. *Pakistan Journal of Zoology* 53(1):55-61. <https://doi.org/10.17582/journal>
- Faraz A, Waheed A, Mirza R.H, Ishaq HM (2019a). The camel a short communication on classification and attributes. *Journal of Fisheries*

- and Livestock Production 7(01):289.
- Faraz A, Waheed A, Mirza RH, Ishaq HM (2019c). Role of camel in food security: A perspective aspect. *Journal of Fisheries and Livestock Production* 7(01):290.
- Faraz A, Waheed A, Mirza RH, Ishaq HM, Tariq MM (2019b). Socio economic status and associated constraints of camel production in desert Thal Punjab, Pakistan. *Journal of Fisheries and Livestock Production* 7(01):28.
- Faraz A, Waheed A, Mustafa AB, Tauqir NA, Mirza, RH, Ishaq HM, Bilal RM, Nabeel MS (2021a). Milk production potential of Marecha camel (*Camelus dromedarius*) in extensive and semi-intensive management systems. *Pakistan Journal of Zoology* 53(1):273-280. <https://doi.org/10.21162/PAKJAS/18.4631>
- Faraz A, Younas M, Lateef M, Muhammad G (2018). Effect of intensive and semi-intensive management systems on growth performance and economics of Marecha (*Camelus dromedarius*) calves reared under desert conditions. *Pakistan Journal of Agricultural Science* 55:625-632.
- Faraz A, Younas M, Pastrana C, Waheed A, Tauqir NA, Nabeel MS (2021b). Socio-economic constraints on camel production in Pakistan's extensive pastoral farming. *Pastoralism: Research, Policy and Practice* 11:2.
- Faye B (2015). The camel today: Assets and potential. *Anthropozoological* 49:167-176.
- Faye B, Abdelhadi O, Ahmed AI, Bakheit SA (2010). Camel in Sudan: Future Prospects. *Livestock Research for Rural Development* 23(10):11.
- Faye B, Chaibo M, Gilles V (2012). Integrated impact of climate change and socioeconomic development on the evolution of camel farming system. *British Journal of Environment and Climate Change* 2:227-244.
- Fazal MA, Howlader MMR, Zaman MA (2017). Productive and Reproductive Performances of Camel (*Camelus dromedarius*) in Bangladesh. *Journal of Veterinary Medicine and Surgery* 1:1-5.
- Hamed H, El Feki A, Gargouri A (2017). Influence of Wet and Dry Season on Milk Composition of Dromedary Camels (*Camelus dromedarius*) from Tunisia. *Iranian Journal of Applied Animal Science* 7(1):163-167. <https://doi.org/10.21162/PAKJAS/18.4631>
- Jabir T, Lishan A, Tadesse B, Ayele G (2017). Major Health and welfare Problems of Camels in Dire Dawa Administration Council, Eastern Ethiopia. *Researcher* 9(4):84-88.
- Kadim IT, Mahgoub O, Mbagu M (2014). Potential of camel meat as a non-traditional high quality source of protein for human consumption. *Animal Frontiers* 4:13-17.
- Kedija H, Azage T, Mohammed YK, Berhanu G (2008). Traditional cow and camel milk production and marketing in agro-pastoral and mixed crop –livestock system: the case of Mieso district, oromia regional state, Ethiopia. IPMS (Improving productivity and market success) of Ethiopia farmers project working paper 13. ILRI (International Livestock Research Institute)
- Kurtu MY (2004). An assessment of the productivity for meat and carcass yield of camels (*Camelus dromedaries*) and the consumption of camel meat in the eastern region of Ethiopia. *Tropical Animal Health and Production* 36:65-76.
- Mahamed A, Haji A, Beriso K, Gebeyew K (2015). Small camel holder camel milk production performance in Jijiga district, Somali regional state Eastern Ethiopia. *Journal of Veterinary Science and Technology* 6:267.
- Mahgoub O, Kaim IT (2012). Camel research and development in sultanet of oman. In: Seyoum Bediye, Sisay Tilahun, Getachew Animut, Mehadi Egie, Tezera Getahun, eds. Bridging knowledge and technology gap in camel production. Proceedings of international conference on camel research and development held in jig jiga, Ethiopia, October 27-29, 2011. pp.45-61.
- Megersa B, Regassa A, Kumsa B, Abuna F (2008). Performance of camels (*Camelus dromedarius*) kept by pastoralists with different degrees of experience in camel keeping in Borana, Southern Ethiopia. *Animal Science Journal* 79:534-541.
- Mekuriaw Z (2007). Non-genetic factors affecting milk yield and milk composition of traditionally managed camels (*Camelus dromedarius*) in Eastern Ethiopia. *Livestock Research for Rural Development* 19:85.
- Melkamu Tefera, Fesseha Gebreab (2001). A study on the productivity and disease of camels in eastern Ethiopia. *Tropical Animal Health and Production* 33:265-274.
- Mitiku E (2012). Camel meat production and implication to meat industry. In: Seyoum Bediye, Sisay Tilahun, Getachew Animut, Mehadi Egie, Tezera Getahun, eds. Bridging knowledge and technology gap in camel production. Proceedings of international conference on camel research and development held in jig jiga, Ethiopia, October 27-29, 2011. pp.151-157.
- Mitiku EG, Getachew N (2015). Camel slaughtering practice and meat production in eastern Ethiopia. *Science, Technology and Art Research Journal* 4(3):123-128.
- Moges D, Mengistu U, Getachew A, Mohammed YK, Sisay T (2016a). Effect of concentrate supplementation to free ranging dromedary camels on yield, physico-chemical quality and fatty acid profile of milk. *Livestock Research for Rural Development* 28:1-12.
- Moges Dereje, Mengistu Urge, Getachew Animut, Mohammed Y Kurtu (2016b). Feedlot performance of Ogaden dromedary camels fed urea-treated maize stover and concentrate mixture. *Livestock Research for Rural Development* 28(10).
- Mohammed YK, Ali S, Mengistu U (2017). Camel (camelus dromedaries) meat production potential and associated constraints in Eastern Ethiopia. *Eastern Africa of Veterinary and Animal Science* 1(2):77-86.
- Mwinyikione Mwinyihija, Mekonnen Hailemariam COMESA-Leather and Leather Products Institute (2016). Preview of Camel (*Camelus dromedarius*) hides marketing and challenges in Eastern Africa. *Journal of Africa Leather and Leather Products Advances* 3(1):2410-0838.
- Osman AM, Abdelkreim M, Abukashawa SMA, Ibrahim MT (2015). Studies on camels milk feeding and utilization of camel in Buttana Area Gaderif state, Sudan. *Advance in Dairy Research* 3:141.
- Patil NV, Gupta R (2012). Achievements and strategy of camel research and development in India. In: Seyoum Bediye, Sisay Tilahun, Getachew Animut, Mehadi Egie, Tezera Getahun, eds. Bridging knowledge and technology gap in camel production. Proceedings of international conference on camel research and development held in jig jiga, Ethiopia, October 27-29, 2011. pp. 45-65.
- Shishay G, Mulugeta F (2018). Camel milk production, prevalence associated risk factor of camel mastitis in Aysaita woreda Afar regional state, North East Ethiopia. *ARC Journal of Animal and Veterinary Science* 4(3):17-37.
- Simenew K, Dejen T, Tesfaye S, Fekadu R, Tesfu K, Fufa D (2013). Characterization of Camel Production System in Afar Pastoralists, North East Ethiopia. *Asian Journal of Agricultural Sciences* 5(2):16-24.
- Sisay K, Getachew A, Lemma Z (2015). The contribution of camel milk to pastoralist livelihoods in Ethiopia: An economic assessment in Somali Regional State. IIED Country Report. IIED, London.
- Solomon M, Kuluberhan A, Angesom H (2017). Camel Milk Production and Marketing: Challenges and Opportunities in Afar Regional State, Ethiopia. *Food Science and Quality Management* 61:2224-6088.
- Tekle T, Tesfay Y (2013). Production potential of camels (*Camelus Dromedarius*) under pastoral and agro-pastoral systems in North Afar, Ethiopia. *Livestock Research for Rural Development* 25(12):13.
- Tura IG, Kuria HW, Lesuper J (2010). Camel Breeding Management among the Somali, Sakuye, Gabbra and Rendille Pastoralists of Northern Kenya. Kenya Agricultural Research Institute, Tropentag, September 14-16, 2010, Zurich, Kenya.
- Wako G, Menfese T, Ayana A (2017). Camel management as an adaptive strategy to climate change by pastoralists in southern Ethiopia. *Ecological Processes* 6:2.
- Yohannes H, Woldearegay MB, Awot TM (2015). Study on Management Practices and Production Constraints of Camel in Raya-Azebo District, Tigray, Northern Ethiopia. *European Journal of Biological Sciences* 7(1):01-06.
- Yohannes M, Zeleke M, Getachew G (2007). Potentials of Camel Production in Babilie and Kebribeyah Woredas of the Jijiga Zone, Somali Region, Ethiopia. *Livestock Research for Rural Development* 19(4).
- Yosef T, Kefelegn K, Mohammed YK, Mengistu U, Solomon A, Tadelle D, Han J (2014a). Morphological diversities and eco-geographical structuring of Ethiopian camel (*Camelus dromedarius*) populations.

Emirates Journal of Food and Agriculture 26(4):371-389.
Yosef Tadesse, Mengistu Urge, Solomon Abegaz, Mohammed Yusuf Kurtu, Kefelegn Kebede, Taddesse Dessie (2014b). Husbandry and breeding practices of dromedary camels among pastoral communities of Afar and Somali regional states, Ethiopia. Journal of Agriculture and Environment for International Development 108(2):167-189.