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Husbandry and breeding practices of dromedary camels among pastoral communities of Afar and Somali regional states, Ethiopia

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Abstract: The objectives of this paper were to identify and describe husbandry practices, herd structure, owners' trait preferences, breeding practices, and production constraints of camel in the two major camel rearing regions of Ethiopia viz. Afar and Somali, to generate baseline information that would help to plan possible breed improvement strategies and options for the different camel populations. The study sites were selected purposively while households from each of the sites randomly. Data were collected using formal questionnaires and focus group discussion. Results showed that average camel population per household was higher in Mille (28.06±2.27), Gode (27.51±2.02), and Moyale (24.07±2.13) districts. Female camel populations with age of >1 year contributes 78-83 % of the total camel herd population in all the study districts. Higher number of female animals in the herd in the arid environment means providing continuous supply of milk and allows a rapid recovery of herd numbers after a disease outbreak or drought occurrence. This shows that pastoralists breeding objectives are in relation to the arid environment and female population in the herd. Most of the pastoral communities utilize a single breeding male camel per 40-50 female camels and this will affect productivity and heterogeneity of camel population. With regard to trait preference, all pastoral communities ranked milk yield as the first trait of choice, except Moyale district in which adaptation trait was the primary preference. Growth trait ranked second in Mille, Gode, Liben, and Jijiga pastoral communities where as adaptation trait ranked second in Amibara and Shinille pastoral communities. The major camel production constraints were feed, diseases, and lack of water in that order and the major cause of the constraints

was the recurrent drought occurred during the past 2-3 decades in the two regions. Therefore, in planning and implementation of the breeding strategies of camel population breeding program, besides improving some of the traditional practices, the indigenous knowledge of the pastoralists and trait of choice should be considered in order to effectively increase the productivity and satisfy the need of the pastorals.

Keywords: breeding objective, calf management, selection, trait preference.

Introduction

Camel dromedaries are the most capable animal species in utilizing marginal areas in the arid and semi-arid regions and they are able to thrive and produce better than other livestock species under harsh environmental conditions. Many pastoral communities in diverse eco-zones in various parts of the world are dependent on camels for their livelihood. This dependence consists of household utilization of camel meat, milk, leather, and wool, uses as an important sport and tourism resource and as animals for pack, transport, and riding. In Ethiopia, camel is a source of foreign currency from the export of live animal and meat (SPS-LMM 2011) and it is the main source of livelihood for pastoral communities in the country.

As a result of the dependence on camel and long tradition of camel keeping, pastoralists acquired a rich wealth of indigenous knowledge on the production and husbandry practices of camel. Some of the studies (Yohannes, 2007; Eyassu, 2009; Semenew, 2012; Semenew, 2014) described production systems and breeding practices in specific districts. Most of the previous studies on camel were undertaken in few districts (Jijiga, Shinille and Amibara) of which are accessible. Even though few studies were undertaken the number of camel population is higher in some districts like Gode, Afder districts and southern part of Somali region and in the northern part of Afar region. Indicating the husbandry practices of pastoral communities are one thing but studies should indicate short coming of breeding and husbandry practices which are undertaken by pastorals on camel production and its solution to improve camel production and productivity. In addition to that, study output from each of the district should be contrasted to each other to scale up the good and reassess the bad husbandry and breeding practices among the pastoralists. Hence, the piecemeal study approach may hinder implementation and scaling up of the good camel breeding practices among the pastoralists.

The various camel populations that existed in Ethiopia possess different desirable traits for which they are preferred by the pastoralists keeping them. Beyond fulfilling the households' consumption needs, the traits possessed by camels are important items for export. For example, wide hip and chest are an important trait required for beef type animal. However, the present traditional practices and existing challenges

such as presence of breeding male for a long period of time in the herd, absence of continues selection and culling, and presence of high calf mortality remained to be the bottleneck to the productivity of camel and genetic improvement. This study was therefore; conducted with the objective to describe and compare camel husbandry practices, herd structure, owners' trait preferences, breeding practices, and production constraints in the Afar and Somali pastoral communities of Ethiopia. In this study solutions and possible suggestion in relation to livestock sciences were given for bad husbandry and breeding practices of camel. The study was aimed at generating baseline information that will help in planning production and breed improvement strategies and options for the different camel populations.

Materials and Methods

Study area

The study involved two major camel rearing areas, namely, Somali and Afar regional states in Ethiopia. The study sites within each area were purposively selected based on the presence of higher camel population, security and transport access while households within sites were selected randomly. Eight rural kebeles (RK), the smallest administrative unit in Ethiopia) two each from Jijiga, Gode, Shinille, and Moyale Districts represented the sample sites in the Somali national regional state (SNRS). The sample sites in Afar national regional state (ANRS) included four Rk, two each from Mille and Amibara districts. Shinille and Jijiga study sites are geographically found between 9°00' N-10°00' N latitude and 42°00' E - 43°30' E longitude. Gode site is located between 6° N - 6°30' N latitude and 43° E - 43°30' E longitude. Moyale site is situated between 3°30' N - 4°00' N latitude and 39°00' E - 40°00' E longitude. The corresponding location for Mille and Amibara sites is between 11°21'-11° 30' N latitude, 39°38' - 40° 45' E longitude and 09° N - 10° N latitude and 39°45' E - 40°30' E longitude, respectively (Figure 1).

The average altitude of Amibara district is 740 masl with mean annual temperature of 34.1 °C. The rainfall distribution varies from year to year with average mean annual rainfall of about 575 mm. In general, arid and semi-arid climatic environment is the typical characteristics of the district (Getachew, 2001). In Mille district, the average annual temperature ranges from 23 °C to 44 °C. The hottest months are from February-September. The annual rainfall is less than 200mm (Firew *et al.,* 2011). Gode district is characterized as semi-arid with an average rainfall of 500 mm per annum. The average precipitation varies from 0 mm in the dry season months of July/August to 110 mm in April during the main rainy season with average mean annual rainfall of about 400 mm. Temperatures vary from 19°C to 36 °C (Mohammed, 1999). Temperature around Jijiga areas is generally high all the year round where the mean

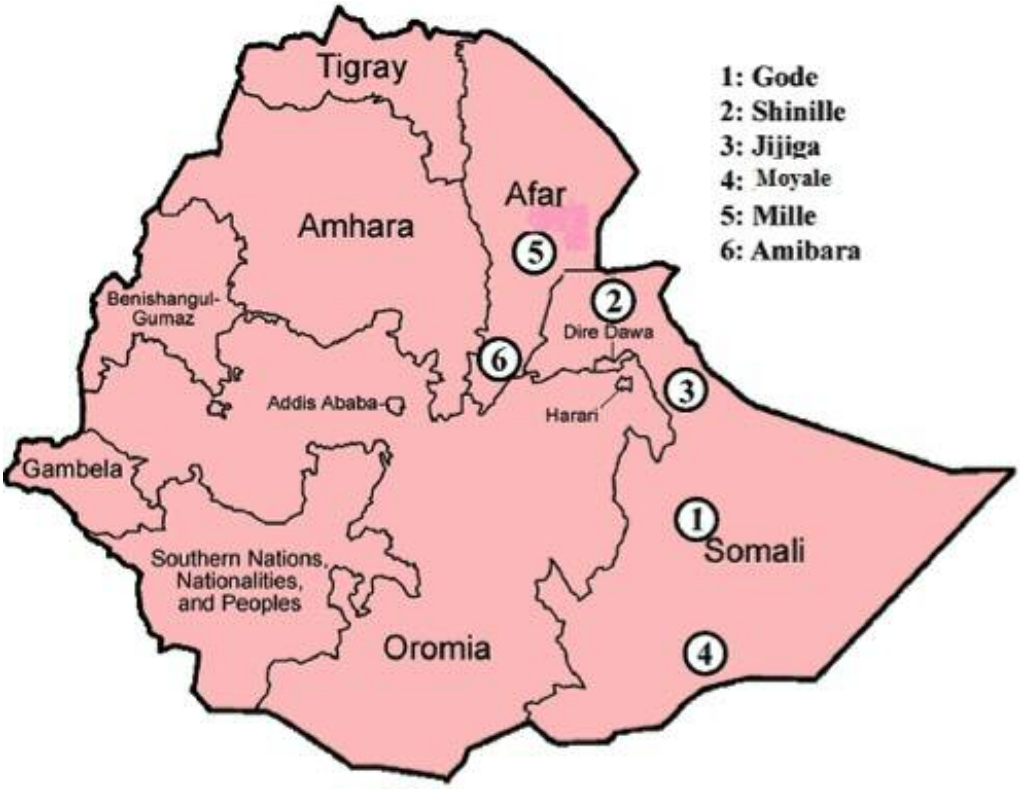

Figure 1 - Map of the Study sites in Afar and Somali Regional states, Ethiopia.

minimum value is around 20 °C and the mean maximum around 30 °C. According to National Meteorological Service Agency (NMSA, 2000) the mean annual rainfall is 660 mm and it is bimodal. The rainfall in Jijiga zone is generally low, unreliable, and unevenly distributed. Shinille district is characterized by unreliable and erratic rainfall with a precipitation ranging from 300 to 600 mm per annum, high ambient temperature (>30 °C), sparsely distributed vegetation, which is dominated by *Cactus* and *Acacia* species, and bushy woodlands (Bekele, 2001). The climate of Moyale district is arid with a mean annual temperature of 27 °C. The mean rainfall of the district is less than 450 mm and have low humidity (Save the children, 2002).

Methods of data collection

A total of 205 households (HH) were selected from the study areas. The distribution of households across the sample sites were 43, 34, 30, 32, 34, and 32

households from Moyale, Gode, Jijiga, Shinille, Amibara, and Mille districts, respectively. Data collection was conducted using semi-structured questionnaire with the help of trained enumerators speaking the local languages. Additional relevant information was generated and physical data such as trends of rainfall and temperature were obtained through the informal group discussion held with key informant consisting of elders, community leaders, and development agents at various levels. One group discussion per site was held with the group discussants. Information generated during the group discussion includes husbandry practices of camel rearing, historical perspectives, and people's perception of camel rearing, understanding of breed characteristics in terms of milk yield, resistance to drought and related environmental hazards, selection criteria, and camel production constraints.

Data Analysis

Software packages of SPSS version 16 and SAS (2008) were employed to generate descriptive statistics. For the categorical data set, the Cochran–Mantel–Haenszel chi-square statistics was employed to compare differences in husbandry practices between and within districts and regions. Indices were calculated to analyze the ranking of purpose of keeping camel population, trait preference, and selection criteria. The ranking was expressed as an Index = Sum of (4 for rank 1 + 3 for rank 3 +2 for rank 2+ 1 for rank 4) given for an individual reason divided by the sum of (4 for rank 1 + 3 for rank 3 + 2 for rank 2 + 1 for rank 4) for overall reasons (Kosgey, 2004).

Results

Herd structure and composition

Average number of camel population per household is indicated in Table 1. Differences existed between the districts in the number of camels owned per household. Maximum camel number per household was found in distant and inaccessible districts while lower number of camel population per household was found in areas located close to the urban areas.

Average number of female camels aged greater than 4 years and those in the age between 1 to 4 years in the herd are shown in Table 2. In both Afar and Somali pastoral communities age at puberty of female camel is 4(four) years of age. Number of female camels aged greater than 4 years per household in the three districts (Gode, Jijiga and Moyale) of Somali regional state were higher than households in Afar (Amibara and Mille), and Shinille districts. More matured female camels were observed in the camel herd per household of Jijiga and Moyale districts in comparison to other study areas.

Average number of female camel between 1-4 years of age per households in Gode

and Mille districts was higher than all the other districts, whereas Moyale and Jijiga districts households own lower number as compared to the other districts. In all the study districts, percentage of female camels with age greater than 1 year per household were between 66.3 and 75.7 %. The female camel including calves (7.3 - 11.7 %) contributes 78-83 % of the total camel herd size.

Likewise, the number of breeding and castrated male camels owned by the households is significantly different among districts which is higher in Afar (Amibara and Mille) and Shinille districts. Every household in Shinille district has at least one male camel. Castration of male is practiced only by Somali pastoralists, which was higher in Gode and Moyale districts than the other districts in Somali National Regional State.

Table 1 - Average camel herd size per household in the study districts.

Districts	N	Mean (S.E.) herd size	Range	Total number of camels	CV for herd size
Amibara	34	19.2(2.44)^{b}	4-50	558	68.4
Gode	34	27.5(2.02)^{a}	6-52	1073	45.9
Jijiga	30	20.4(1.93)^{b}	4-40	654	53.5
Moyale	43	24.1(2.13)^{ab}	8-50	698	47.7
Mille	32	28.1(2.27)^{a}	8-53	898	45.8
Shinille	32	20.2(1.67)^{b}	2-35	607	45.1

^{ab}means bearing different letter superscripts in a column are significantly different from each other at P<0.05.

Table 2 - Proportion of female camels in the herd per household in the study districts

Districts	Female between 1-4 years (Mean (S.E))	%	Range	CV	Female>4 years (Mean (S.E))	%	Range	CV
Amibara	7.45(0.97)^{c}	38.7	2-20	69.8	5.31(0.80)^{d}	27.6	1-15	81.0
Gode	10.2(0.61)^{ab}	37.1	4-18	37.2	8.97(0.89)^{ab}	32.6	0-22	62.2
Jijiga	10.4(1.13)^{ab}	51.1	3-25	61.2	4.44(0.43)^{d}	21.5	0-8	55.2
Moyale	12.1(1.11)^{a}	50.1	2-25	49.5	6.17(0.62)^{c}	25.6	1-13	53.9
Mille	9.75(0.87)^{b}	34.7	3-20	50.3	10.9(1.01)^{a}	38.9	1-22	52.4
Shinille	7.73(0.64)^{c}	38.2	2-14	45.4	7.03(0.73)^{b}	34.8	0-15	56.6

^{abcd}means bearing different letter superscripts in a column are significantly different from each other at P<0.05

Trait preferences

Trait preference indices in Afar (Amibara and Mille pastorals) and Shinille communities demonstrated that milk production ranked first (Table 4). Adaptability, breeding efficiency, growth, ability to give birth to more female and draught capacity

Table 3 - Average number of breeding and castrated male camels per household in the study districts.

Districts	Breeding male (Mean (SE))	(%)	Range	CV	Castrated Mean(S.E)	%	Range	CV
Amibara	1.59(0.23)^{b}	8.3	0-5	91.5	0.00	-	0	-
Gode	1.05(0.26)^{bc}	3.8	0-3	104.5	1.15(0.19)^{a}	6	0-6	100
Jijiga	0.88(0.24)^{c}	4.3	0-4	80.8	0.50(0.16)^{b}	1.8	0-2	175
Moyale	1.07(0.15)^{bc}	4.4	0-3	49.6	0.86(0.15)^{ab}	3.6	0-3	91.5
Mille	2.03(0.22)^{a}	7.2	0-5	70.2	0.00	-	0	-
Shinille	1.60(0.15)^{b}	7.9	1-4	55.9	0.60(0.12)^{b}	2.7	0-2	119

^{abc}means bearing different letter superscripts in a column are significantly different from each other at $P<0.05$

traits followed milk production with changes in rank across the different sites.

In Somali pastoral communities (Gode and Jijiga) milk production and adaptation traits ranked 1st and 2nd, respectively (Table 4) while ability to give birth to more number of female than male calves and draught capacity ranked 3rd. As opposed to the other study sites where at least milk production is rated as most important trait, Moyale pastoral community's trait preference indices indicate adaptation to be the priority trait to the community followed by growth and milk yield in their order of importance. In all Somali and most Afar pastoral communities, adaptation trait ranked 2nd in their trait preferences.

Selection and breeding practices

Number in the herd and age at selection of breeding male in the six districts are indicated in Table 5. Majority of the households in Amibara, Mille and Gode districts keep a single breeding male in their herds. Almost all households in Shinille and majority of Jijiga and Moyale districts keep 2-4 breeding male camels in the herd.

Sources of breeding camel and selection and replacement practice of breeding males are shown in Table 6. Overall, the selection of the bull is done at maturity in Afar and early age in Somali except Shinille communities. Two-third of the respondent in Gode, Jijiga, and Moyale districts noted that male camels not selected for breeding purpose are removed by selling or castrated and left in the herd to be used as transport animal.

In Mille and Amibara districts male camels were reared separately except during breeding season while in Shinille, both sexes reared and browse together except during dry season. During the dry season all female camels are moved to areas of better feed availability but male camels are normally kept around settlement area to be used for transportation of goods.

Table 4 - Ranking indices on traits preferences of camels in the communities of study areas.

Districts	Rank	Traits					
		Milk yield	Adaptation	Growth	Breeding efficiency	Giving birth to more female calves	Draft
Amibara							
	1	25	2	0	10	0	0
	2	5	26	4	2	0	0
	3	0	6	15	6	10	0
	4	7	3	9	11	3	4
	Index	0.34	0.28	0.14	0.19	0.06	0.01
	1	32	0	0	0	0	0
	2	0	2	10	0	20	0
Mille	3	0	9	22	0	0	1
	4	0	21	0	9	0	2
	index	0.40	0.14	0.23	0.03	0.19	0.01
	1	19	6	0	0	0	7
	2	5	4	6	0	0	17
Shinille	3	2	7	15	0	0	8
	4	6	15	8	2	1	0
	index	0.32	0.20	0.18	0	0	0.29
	1	26	5	0	0	0	0
	2	0	24	0	5	2	0
Gode	3	5	0	11	7	6	2
	4	0	2	6	9	6	8
	index	0.37	0.30	0.09	0.12	0.08	0.04
	1	10	14	6	0	0.	8
	2	5	9	11	0	7	6
Moyale	3	4	3	20	0	1	10
	4	16	4	1	3	10	4
	index	0.21	0.24	0.26	0	0.09	0.19
	1	32	0	0	0	0	0
	2	0	24	0	0	8	0
Jijiga	3	0	8	3	0	21	0
	4	0	0	27	1	3	1
	index	0.44	0.30	0.11	0.003	0.24	0.003

Index is calculated as: Index = Sum of (4 for rank 1 + 3 for rank 3+2 for rank 2+ 1 for rank 4) given for an individual reason divided by the sum of (4 for rank 1 +3 for rank 3+2 for rank 2 +1 for rank 4)

More than three-fourth of the households of Amibara, Mille, and Shinille districts replied that the sources of breeding male were from their own herd, while the remaining households indicated that their breeding males were acquired or purchased from outside their herds. The sources of breeding camel for about 87 and 44 % of the respondents in Jijiga and Gode districts is from their own herds. More than half of the interviewed households in Amibara and Mille and one-third of the respondents from Shinille practice selection of breeding males from their herds. The majority of the respondents from Gode and Mille districts keep breeding male camel in the herd for about 7-10 years whereas households in Amibara, Jijiga, and Moyale districts keep

for only 3 to 6 years. In the present study, significant differences were observed between study sites in the source and number of years the breeding males is kept in the herd.

Table 5 - Number per herd, age at selection, and fate of unselected male camels in the study districts.

Districts	Number of breeding male per herd		Age at selection (years)		Fate of not selected for breeding purpose		
	One	two-four	at maturity (5-6)	1-4	Sold	Leave in herd	castrate
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Amibara	18(62.1	11(37.9)	12(75.0)	4(25.0)	15(51.7)	14(48.2)	-
Mille	10(31.3	22(68.8)	8(80.0)	2(20.0)	6(18.7)	26(81.2)	-
Shinille	1(3.13)	31(96.8)	4(66.6)	2(33.3)	8(25.0)	24(75.0)	-
Gode	23(67.6	11(32.3)	7(58.3)	5(41.6)	23(67.6)	4(11.7)	7(20.5)
Jijiga	18(60.0	12(40.0)	5(19.2)	21(80.7	20(66.6)	4(13.3)	6(20.0)
Moyale	16(37.2	27(62.7)	10(71.4)	4(28.5)	30(69.7)	2(4.65)	11(25.5)
Overall	86(43.6	114(56.4	38(48.4)	37(51.5	102(49.9)	74(50.0)	24(11.0)

N=200

Table 6 - Source, selection practices, and duration of breeding male camel retained in the herd.

Districts	Source of breeding camel			Practice of selecting own breeding male		Period of keeping breeding male		Practice of replacing male born to	
	Own herd	other herd	purchased	Yes	No	3-6	7-10	Yes	No
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Amibara	29(85.3)	5(14.7)	-	16(55.1)	13(44.8)	14(48.2)	15(51.7)	24(82.7)	5(17.2)
Mille	28(87.5)	4(12.5)	-	10(31.2)	22(68.7)	-	32(100)	32(100)	-
Shinille	23(71.8)	8(25.0)	1(3.13)	6(26.1)	17(73.9)	10(41.6)	14(58.3)	23(100)	-
Gode	15(44.1)	19(55.8)	-	12(80.0)	3(20.0)	21(61.7)	13(38.2)	15(100)	-
Jijiga	26(86.6)	4(13.3)	-	26(100)	-	4(13.3)	26(86.6)	26(100)	-
Moyale	14(32.5)	14(32.5)	15(34.8)	14(100)	-	9(31.0)	20(68.9)	14(100)	-
Overall	139(70.0)	50(23.5)	16(6.34)	74(60.2)	65(39.7)	58(32.6)	120(67.3)	134(97.1)	5(2.87)

#Overall: Chi-Square (56.1, $P < 0.001$ and 99.9, $P < 0.001$) was found between source and time of keeping breeding male, respectively. N=205.

Calf management and weaning

Suckling and weaning practices of calves in the six districts is indicated in Table 7. In this study, more than 85 % of the pastoral communities' understand the benefit of

Table 7 - Suckling and weaning practices of camel calve.

Districts	Knowledge about the importance of colostrum		Access to suckling with reference to birth		Practice of weaning	
	Yes	No	Just after birth	After three days	Yes	No
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Amibara	31(91.1)	3(8.82)	30(88.2)	4(11.7)	28(82.3)	6(17.6)
Mille	32(100)	-	26(81.2)	6(18.7)	25(78.1)	7(21.8)
Shinille	28(87.5)	4(12.5)	27(84.3)	5(15.6)	24(75.0)	8(25)
Gode	29(85.2)	5(14.7)	26(89.6)	8(23.5)	34(100)	-
Jijiga	26(86.6)	4(13.3)	23(88.4)	7(23.3)	30(100)	-
Moyale	35(81.4)	8(18.6)	34(79.0)	9(20.9)	43(100)	-
Overall	181(88.2)	24(11.7)	166(80.9)	39(19.0)	184(89.7)	21(10.2)

N=205

Table 8 - Type and age of weaning and health of calve after weaning.

Districts	Type of weaning		Age at Weaning				Health problem after weaning	
	Partial weaning N (%)	Abrupt weaning N (%)	8 month N (%)	12 months N (%)	18 month N (%)	2 years N (%)	Yes N (%)	No N (%)
Amiba	8(28.5)	20(71.4)	-	28(100.0)	-	-	2(5.9)	32(94.1)
Mille	25(100.0)	-	15(60.0	10(40.0)	-	-	12(48.0)	13(52.0)
Shinill	6(25.0)	18(75.0)	1(4.2)	-	-	23(95.8	1(3.1)	23(96.8)
Gode	19(55.8)	15(44.1)	-	27(79.4)	7(20.5)	-	4(11.7)	30(88.2)
Jijiga	18(60.0)	12(40.0)	-	-	2(6.7)	28(93.3	-	30(100.0)
Moyale	34(79.0)	9(20.9)	8(18.6)	12(27.9)	23(53.4	-	11(25.5)	32(74.4)
Overall	110(59.7)	74(40.2)	24(13.0	77(41.8)	32(17.3	51(27.7	30(15.7)	160(84.2)

N=184

colostrum milk feeding. Among the households interviewed in Amibara, Mille, and Shinille districts, the majority of the households allowed the calf to start suckling just after birth and practiced weaning. Similarly, more than 85 % of the households in Gode, Jijiga, and Moyale districts let the calf to start suckling just after birth. Overall, only 1/5 of the households from the six districts allowed calves to start suckling after three days.

Weaning type and age of camel calves in the six districts is indicated in Table 8. Among the households that practice weaning in Amibara and Shinille districts, three-fourth of the households practice abrupt weaning and the remaining households in

the two districts and the entire households in Mille district practice partial weaning. In Gode and Jijiga districts, the entire households practice calf weaning of which 50% employ partial weaning. Generally, 3/5 and 2/5 of the interviewed households wean calves partially and abruptly, respectively. There is no household that wait the calf to wean naturally. All households in Shinille and Amibara districts wean calves at the age of 2 years and one year, respectively. In Mille district two-third and one-third of the households wean calves at 8 and 12 months, respectively. In Gode and Jijiga districts, majority of the households weaned the calves at 12 and 24 months, respectively. In Moyale districts half of the households' weaned calves at 18 months and the remaining half weaned at 8 and 12 months. Overall, the results of the present study revealed that the majority (59.24 %) of the pastoral households in Ethiopia wean camel calves at the age of 12-18 months.

The occurrence of disease problem after weaning was low in Amibara and Shinille districts, whereas half of the weaned calves were said to be affected by different diseases (mange, ticks and tick born diseases) after weaning in Mille district. About 12 respondents in Gode and 25 % in Moyale districts complained of health problems in calves after weaning. The major health problems mentioned in calves at early age was diarrhea, mange, and ticks.

Table 9 - Major constraints to camel production in the study districts.

Major production constraints	Amibara	Mille	Shinille	Gode	Jijiga	Moyale
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Feed	12(35.2)	12(37.5)	13(40.6	6(17.6)	10(33.3)	10(23.2)
Drought	10(29.4)	11(34.3)	12(37.5)	11(32.3)	8(26.2)	11(25.5)
Diseases (Mange, mastitis, camel dermatophilosis and trypanosomiasis)	8(23.5)	6(18.7)	5(15.6)	8(23.5)	-	8(18.6)
Lack of water	4(11.7)	3(9.3)	2(6.25)	3(8.8)	8(26.2)	8(18.6)
Access to market	-	-	-	6(17.6)	-	-
Conflict over scarcity of natural resources	-	-	-		4(13.3)	6(13.9)

N=207

Production constraints

List of identified constraints to camel production are depicted in Table 9. The present study identified feed, drought, disease, and water to be the four major camel production constraints in Afar (Amibara and Mille) and Somali (Moyale, Jijiga, and Shinille) regional states. Water scarcity was not mentioned as a constraint in Gode district, but market is claimed to be a serious problem in addition to feed scarcity, recurrent drought, and disease.

Discussion

Pastoral communities in Ethiopia are dependent on milk as one of the major human diet. Even though different livestock species are reared in their herds of livestock to avoid risk in these areas, camel is the major milk provider (CSA 2007). Thus, the presence of large number of camel population dominated by females is indicative of the importance of camel as a milk provider to pastoral community, in addition to the adaptability of the animal to hostile environment of the area (Yosef *et al.*, 2013). Camels are also a first priority needed animal in the community to provide services such as monetary income and fulfillment of social obligations such as wedding, holiday, religious ceremony, and means of payment of blood money to the lineage of the deceased (Ahmed, 1989; Hussein, 1993). The present study highlighted availability of feed, impact of disease, importance of camel milk in comparison to other livestock species (sheep and goat milk) to the family to be the determinant factors to limit the number of camels owned by the households. This is because if milk of other species is more important than camel milk in the family of a community they will rear more number of other species than camel. In agreement with the present finding, study by Save the Children (2002) demonstrated that feed availability and importance of camel milk to the household to be the major determinant factors to determine the size of camel populations. Thus, the relatively lower number of camel populations in Amibara, Shinille, and Jijiga districts may be due to the scarcity of grazing land and feed. The presence of large cities and bush encroachment around these study areas might have contributed to the decrease in the grazing land and availability of browsing plants. In Shinille study area, it was also reported that large volume of milk is obtained from other livestock species such as sheep. This may indicate decreasing camel number in the study area of Shinille because of the importance of sheep milk for the community. The implication of the finding is that the traditional camel production system, that is extended rangeland dependence for camel feed will no longer a system to continue in these areas in the future. Therefore, alternative production system should be implemented for camel production to continue to be important supplier of livelihood needs in such areas. The lower number of young camel populations in some of the study areas (Jijiga and Moyale) may be related to the accessibility of the areas to foreign trade, which created opportunity for exportation of camels without considering age, sex, and camel populations (Liben, Hoor, Gelleb). In this regard, the study conducted by Tariku *et al.* (2013) indicated that the number of female camels in southern part of the country decreased because of the indiscriminate exportation of all age and sex categories.

The average number of camels owned by pastoralist households reported in earlier studies conducted in Shinille and Jijiga (Yohannes, 2006; Eyassu, 2009) and in Afder districts (Ahmed, 2002) were higher than the present. It is also lower than the reported

herd size of 62-75 camel in Sudan (Isag, 2011). This may be attributable to the scarcity of feed and occurrence of recurrent drought over the past two decades in these areas. The study in Afder district which is an area adjacent to Gode district reported average camel populations of 30-35 per households (Ahmed, 2002). In the contrary, the number of camel population is said to be increasing from time to time in Ethiopia (Yosef *et al.,* 2013). Nevertheless, the present study demonstrated reduced camel number per household. The increment in the camel population is related to increased number of households owning camel in areas where camel production exists and expansion of camel rearing to regions previously camel is not the component of livestock husbandry.

In Afar and Somali pastoral societies, wealth is assessed mainly on the basis of the number of female camels' owned. The main reason for pastoralists owning more number of female 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. Thus, presence of higher number of female in all age groups in the herd is to ensure food availability and to facilitate herd recovery from the death due to recurrent droughts in the area. The dominance of camel herd by high percentage of female camel in this study was similar to the results reported in studies conducted in Kenya (Wilson, 1984), Afar region of Ethiopia (Gebrehiwot, 1998; CACC, 2004), and The Sudan (Isag, 2009). Significant difference between districts and regions in herd composition suggests differences in the breeding objectives. Nevertheless, difference among regions did not exist in previous study conducted in The Sudan (Isag, 2009).

Castration of male camels is more practiced in some part of Somali regional state may be due to the demand for some camel breeds (large size and good meat type conformation) for export market than the other breeds in the region. Besides, the presence of castration practices in some pastoral communities may be relevant for the improvement of camel productivity by hindering mating. As observed in this study, some communities keep unselected male camels in the herd, which may cause unwanted mating. Hence, practice of castration should be considered among pastoral communities in order to prevent unwanted mating with poor performing males and between related male and female camels. Although the major objective of castration should be to prevent breeding by unwanted or inferior males, it may also promote ease of handling and better fattening for sale.

Camel as a dowry is the long standing tradition among Afar and Somali pastoral communities. Yohannes (2006) reported that family gift range from 4-10 camels. This kind of family gift is also common in Randille and Gabra community in Kenya (Sato, 1998). The gift can be either from the father or from uncle (mother side) and the occasions of transfer includes mostly marriage (40 %) and circumcision (13 %). In most pastoral communities, the reason of gift of different livestock from the family is to build capacity of youngsters and families affected by natural calamities.

In every pastoral and farming community, breeding management and trait preference indices are one of the activities in their livestock husbandry. Different from other livestock species, selection and culling of breeding female camels are not common in most pastoral communities. Absence of culling in female camel can be an attribute of particularly high calf mortality, long gestation period, and the need to build herd size. This can be an attribute of particularly high calf mortality, long gestation period, and the need to build herd size. Hence, selection and trait preferences indices in pastoral communities are usually focused on breeding bull. Nevertheless, it is interesting to hear from pastoralists that milk production performance, adaptability, and other relevant traits of the dam is considered during breeding bull selection through judgment of the ancestors and progeny of the bull.

The higher trait preference indices of milk yield in the study areas can be related to pastoralists' dietary behavior. In pastoral societies, milk is considered as a staple food. Comparable result was obtained on the studies conducted by Yohannes (2006) and Eyassu (2009) who reported that milk production is the main reason for keeping camels in pastoral areas. In relation to this, the preference for sire that impregnates more female offspring can be related with the need for increasing female camel in the herd to fulfill the demand of milk to the family and to increase herd size.

The second highest trait preference index for adaptation in most pastoral communities may indicate the presence of adaptive camel populations (Liben, Hoor, Gelleb and Amibara) in the communities. This result is comparable with the finding reported by Yosef *et al.* (2014) that indicate the Somali pastoral communities have a preferred camel breed that is more tolerant to water and feed scarcity and resistant to various diseases than other camel population in the herd.

The importance of growth trait can be related with increasing early maturing animal in the herd for meat and milk type camels. The presence of more pack camel and the higher ranking in trait preference indices of draught in some pastoral community may be related with the importance of specific draft animal that can resist the harsh environment and carry heavy load. Even though donkey can resist the arid environment, it is not a suitable animal for heavy load. Besides, camels owned by some pastoral communities have smaller body size and may not fit to market demand and are mainly used as pack animal. The present finding is comparable to those reported by save the children (2002) and Kassahun (2010) on the importance of draught camel and the two parents(male and female camel) giving birth to more proportion of female calves in Shinille and Amibara districts, respectively. Despite strong belief of the pastorals about existence of variation in producing female offspring between breeding male camels, there is no scientific evidence known to the authors if sex-ratio at birth is quite different from unity. Literature usually put female to male ratio at half-half (Hafez and Hafez, 2000) and this dichotomy between scientific literature and pastoralist practice or traditional assumption may need further attention and

investigation. But latest study (Effa *et al.*, 2014) described that cows that show estrus during the harsh seasons (which is the main feature of camel rearing environment) of the years produce more female calves. Therefore, more study should be done to understand the impact of external factors on sex ratios.

Pastoral communities prefer and give higher ranking indices to adaptation trait. This is intended to reduce the impact of recurrent drought and disease on their herd, which is a common phenomenon in all the study areas. In general, the result of the present study in most of the pastoral communities was consistent with the finding of Isag (2009) who reported that milk and meat improvement were ranked first and second, respectively for Sudanese pastorals. Other study (Eyassu, 2009) also indicated that milk production and draught purpose are the major contribution rendered by camels in Jijiga and Shinille districts, respectively. In different livestock species such as cattle (Endashaw *et al.*, 2012) sheep (Save the children 2011), goat (Kassahun, 2010), and camel as revealed by the present study, most of the pastoral communities give priority to milk yield, adaptation, and meat or growth traits in their preference. The present finding of trait preference in camel was in accordance with the study results (Endashaw *et al.*, 2012) who noted on cattle that pastorals emphasize and aim at improving milk production, growth, and improved adaptation to the local environmental challenges. It shows that pastorals give more emphasis for the traits of milk, growth and adaptation in different livestock species.

The higher number of breeding male camels in Afar camel herd may be because of camel based transport, draught, and absence of culling. In addition, the Afar pastorals sale or slaughter their camel only during wedding and holidays. Because of absence of culling in Afar communities, selection of breeding bull is practiced when the male camel approaches breeding age.

In Afar community selection of breeding bull was practiced from their own herds because male family member inherit every camel husbandry practices from their ancestors and they try to maintain the previous breeding practices. In this regard, previous studies (Alemayehu *et al.*, 2001; Kassahun, 2010) reported that Afar pastorals do not cull male camel unless there is sufficient reason notably inability to give birth to more male offspring, old age, aggressiveness, lack of libido, critical need of money by the family, and occasional market price rise.

The lower number of breeding male camel in Somali camel populations can be a result of sale and castration for pack purpose after selection of elite sire. Pastoral communities in Gode very often castrate male camels that failed to meet the selection criteria for breeding. The practice of selecting breeding bull from their own source among Somali pastorals is attributed to the claim by the community that they know the characteristics of the ancestors of the bull. Comparable result was reported by Ali (1989) who revealed that only proven males or males of outstanding ancestors were selected for breeding. Contrary to traditional breeding practices, in sustainable breed

improvement views the pastorals should select 3-5 best breeding male camel from their own herd/s for at least 40-50 female camels. This will decrease inbreeding rate in the herd and improve their productivity. In this regard, selection at early age is more appropriate than mature age to give attention and properly manage the future herd sires.

In most of the pastoral communities breeding male camels are not kept for more than ten years service (18 years of age). This could be because of aging of the breeding bull and inability to mate adequate number of female camels. Comparable result was obtained on the study by Melaku and Fesseha (2001) who described that the reproduction span of camel bull in eastern Ethiopia was 10 years. Ahmed (1989) and Kassahun (2010) also estimated sire breeding life span to be about 20 years, which is not very far from the current and previous findings. The practice of using single breeding male for a long period of time has an impact on the improvement of the breed in both Somali and Afar pastoral communities. Comparable result was obtained on the study (Semenew *et al.*, 2013) indicated that about ¾ of camel herders kept only one breeding male in Afar districts. The number of breeding sires and dams mainly affects inbreeding rate.This is because the presence of lower number of breeding male and female in the herd limit the effective population size and it may be the causes for genetic drift. The impact on the herd is determined by the number of males used in the course of one generation. In this regard, the study conducted by Hans Ekström (2004) described that 3-4 breeding sires must be used per year in a breed with a generation interval of 5-7 years. Hence, number of breeding male camels should be considered in the implementation of breed improvement program.

Seasonal breeding in camel is most of the time related with the presence of ample feeding. The scarcity of livestock feed in the dry season in Afar and Somali regional states hinder the recovery of uterus after calving. Camel breeding starts at the beginning of the rainy seasons (main and short) and continues throughout the season. Selected female camels are bred in each of the season of the year if there is no drought and conception is required. Hence, the male camels are herded separately in the dry seasons from the female camels to control unnecessary mating. The result of the present study with regard to seasonal breeding is consistent with that of Kibebew and Bekele (2001) who noted that all camels of the Afar and Oromo and in the majority of Somalia pastoralists (92 %) showed seasonality in breeding in both sexes. In the contrary, Farah *et al.* (2004) argued that if abundant browse, water, and other favorable conditions are available, camel breeding could occur all year round. Due to high demand of milk in the family, mating thorough out the year may be dependent on the interest of the pastorals. In fact, mating in specific seasons is important to undertake group calves and mating management in planned breeding.

During our discussion with elders on the male to female mating ratio, they responded that on average it is 1:50 up to 1:70 per season in Afar and Somali regional

state, respectively. The number of mating is dependent on availability of feed, age of the male camel, management practices of pastoralists, the condition and stamina of the male, his libido and the fertility level of the females, and other factors. The lower male to female ratio of camel in Afar communities may be due to feed scarcity and harsh environment, since higher ratio requires rainy seasons which provide ample feed to the female to come into heat and strength and stamina to male to serve more females. Comparable result was obtained by Ahmed (2002) who reported that a male camel can mate up to 70 females per season in Afder zone. The study by Melaku and Fesseha (2001) described that the ratio of male to females in a breeding herd is usually around 1:25 but may go up to 1:50. Other study (Williamson and Payne, 1978) also reported a ratio of 1:50. Differently, Hussein (1987) argued that an outstanding male camel can serve 150-200 female camels during the mating season in Somalia state. In order to maintain heterogeneity and reduce inbreeding, study should be done to get the optimum male to female mating ratio in camel. This is because of the small number of breeding males in the herd which may lead to the problem of inbreeding if large female number is used. Besides, male to female ratio should be decided according to the best or the bad seasons (present or absence of feed) of the year. One finding and observation in the present study is that female camel number in the herd in some areas is too low. In launching breed improvement design and strategy in such cases, effective population size should be maintained.

In launching breed improvement design and strategy in such cases, such as in Shinille district, pastoral communities having lower number of female camels should be considered to increase and maintain stable herd composition.

Although, the majority of the pastoral communities allowed the calf to start suckling in the first three days just after birth, most of them said that they limit access of calf to suckling with the purpose to reduce the risk of diarrhea. As indicated by Yagil (1994) this belief is probably due to the normal powerful laxative effect of colostrum. To prevent diarrhea through high intake of colustrum the pastorals practice milking of udder once before the calf suckles leaving only a small quantity of colostrum on the first day of life. Pastoralists claim that if this practice is not followed, calves are likely to get diarrhea, which according to their understanding is the major cause of calf mortality, especially if the dam have high milk yield. Studies by Hartley (1984) and Bornstein (1988) showed that some pastoral communities in the Horn of Africa consider colostrums as harmful to the calf and hence restrict its intake. However, it is rather possible that the high calf mortality usually reported could be attributed to the practice of denying the calves' access to colostrum, among other possible causes.

Weaning is isolation of calve from the mother and it is one of calves management component practiced by pastorals. Weaning is practiced at different age in different pastoral communities. The early weaning age can be related with high milk demand

and utilization by the household. As the study of Ahmed (1989) described, in order to get year-long milk from camel the pastorals employ astute management techniques to induce continued milk production and some of the techniques are such as massage (The camel is called by its name, stopped, and then its udder massaged, it is used to produce milk flow without the presence of a calf or its skin, massage is an easy way of inducing continued milk production by a camel after the death of its calf, skin cover (the skin of the calf(her dead calf skin) put it of the dam or when the dam(mother camel) is out of sight, skin of a dead calf has removed and placed tightly over a foster calf then fresh milk from the mother of the dead calf is sprinkled on the skin) , use of maternal fluids or afterbirth(sometimes the dam give birth to dead calves before the 13 month of gestation period is complete and if a camel aborts after seven months of pregnancy, it can be induced to give milk. This is done by bringing a calf whose mother does not produce enough milk or the herd's youngest calf to the female camel with dead calf or still birth. The calf's mouth is tied with a rope so that it cannot cry out while fresh maternal fluid is rubbed over its body and it is made to sit in front of the mother camel) which bring a female into milk production even though their calves might have died or have been culled or weaned.

Late weaning age can be associated with the interest of the household to get camel milk consistently for a long period of time and to avoid conception of the female because long period of milk let down and conception is related with the availability of feed and uterus recovery. Hence, the presence of calve together with the dam may hinder the recovery of uterus. Some of the factors that influence uterus recovery are categorized as exogenous (genotype, milk yield, age and body condition) and endogenous (nutrition, suckling and season)(Falvey and Chantalakhana 1999).

The overall weaning age of the present study was in agreement with the result obtained by Abebe (1991) and Abdussamad *et al.* (2011) who reported that weaning age of calves was at the age of 12-14 months. Other study (Ali, 1989) reported weaning age of 8-18 months, depending on the browse situation, the milk production of the dam, the growth of the calf, and the ultimate use of the calf (future breeding, sale or slaughter). In this regard in some pastoral communities 2-3 male camels are selected for breeding purpose based on their ancestors and special care is given to them. Special treatment includes providing them ample milk and protecting them from ticks and other parasites. They may not be used for carrying loads. If the male calves are not selected for breeding they will cull or kill at early age. As reported from some part of the study areas weaned calf at early age may be susceptible to disease. Merga (2011) reported possibility of weaning camel calves at 8 months of age and supplementing to age of 12 months. The author reported that this system resulted in good growth rate during post weaning period, higher survivability as measured by absence of mortality, allowing more milk offtake to the camel owners, and reducing competition between the two.

Several methods of weaning were practiced by pastorals of the different study areas of the two regions. The most common practice in Somali and Afar communities are tying the dam's teat with softened bark and making a small incision in the skin of the calf's nostril and inserting thorns that will prick the dam if the calf tries to suckle it and making a small incision at the tip of the calf tongue and inserting a piece of wood that will hurt the calf itself when it tries to suckle are some of these. Whatever the method is, the calf will stop the suckling habit within three or four weeks.

In the present study the major camel production constraints were lack of feed, drought, diseases, and lack of water. Mastitis and mange mites problem were reported in all the study areas. In addition to that, trypanosomiasis had significant impact on the productivity of camel in Afar regional state and Gode district. The main causes for the various production constraints in the study area were inaccessibility to transportation, absence of various social infrastructures (education, health), and poor animal health delivery system. These all makes the area more liable for livestock production constraints. The present result is supported by Zeleke (1998) and Kassahun (2010) who reported the same production constraints in Somali and Afar regions, respectively. Other study (Zeleke and Bekele 2000) indicated that trypanosomiasis and sarcoptic mange were the most important diseases identified in Errer Valley, Eastern Ethiopia.

Surprisingly, fodder production practices emerged around the urban centers as new phenomenon to boost livestock productivity in Somali regional state. Pastoralists around Towns like Gode and Kelafo began fodder production for their animals especially for camels. The study conducted by Abdi *et al.,* (2011) also found the same trend in areas like Dollo Ado and Chirati Towns in Somali regional state. Most of these towns are located in areas where irrigation is possible. The Somali Pastoral and Agro-pastoral Research Institute (SORPARI) is involved to encourage and improve this initiative through researching the best suitable fodder species to the specific sites. The implication of such practices is that in areas where there are opportunities, and where the extensive range camel production system is no more feasible because of urbanization, industrialization, and large irrigated farm development, an intensive or semi-intensive production system is the option and it already starts to emerge in the country.

Conclusion

- Selection and culling of female camel is not done in all pastoral communities. But performance of the dam is observed through the ancestors of the breeding bull. Although this is good to retain elite animals, selection for female should be also encouraged.
- In Arid environment, increasing female camel in the herd and producing more

milk is the main breeding objectives. The trait preferences of pastoral communities for early maturing camel indicate the need for rapid growth in camel.

- Indigenous knowledge (identifying superior meat and milk producing and disease resistance camels, trait preferences, traditional disease treatment, best breeding and husbandry practices) of pastoral communities should be considered in planning and implementation of smallholder camel breeding programs.
- The pastoral communities faced various livestock production constraints, hence attention should be given to feed and disease problem to enhance camel productivity**.**
- Pastoralists should be educated concerning the importance of colostrums milk and the reason of high camel calve mortality during early age in pastoral camels should be identified and solution proposed and implemented.

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