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Production systems and reproductive performances of *Camelus dromedarius* in Somali regional state, eastern Ethiopia

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Abstract: Across-sectional questionnaire survey and focused group discussions were conducted to characterize camel production systems and to evaluate reproductive performances of camels at their natural pastoralist management systems of Somali region. A total of 100 households were included in the study during the period of October 2012 to March 2013. About 98% of Somali pastoralists preferred camels as their first choice over other livestock species and mainly kept in the society for milk and meat production. The camel management dominating in the study areas of Somali region is traditional nomadic. Camel is one of the most important livestock for Somali pastoralists' livelihood as a source of milk, meat and draught power. Mature female camels were dominant (54.87%) in the camel herd. The ratio of male to female camel was 1:13. Mean age at first calving and calving interval were 62.16±10.44 and 23.28±3.36 months respectively. Age at first calving and calving interval can be minimized to 57±5.52 and 21.84±4.8 months by proper husbandry and health care. The mean lactation length was 11.51±1.91 months. Diseases and predators were reported as the main causes of calf mortality. Calf mortality rate among Somali camels can be reduced at least to 7% only by preventing predators attack and if other disease prevention and management cares are in place it can be reduced to maximum. Diseases (66%), lack of pasture (59%) and security (47%) were the main constraints in camel production of the study areas. For the better productivity of camels, the major constraints such as disease problems, lack of pasture and tribal conflicts should be mitigated. Proper

husbandry and health services can play significant roles in the long term improvement of camel production and productivity of the region.

Keywords: Camelus dromedarius*, production system, reproductive performance, Somali.*

Introduction

The one humped camel (*Camelus dromedarius)* is uniquely adapted domestic animal in arid and semiarid environment. About 85% of the camel population inhabits mainly eastern and northern Africa and rest in Indian subcontinent and Middle East counties. Somalia has the highest population of 7.00 million followed by Sudan 4.25 million and Ethiopia 2.4 million camels (FAO STAT, 2011). The majority of world's camel population is of dromedary type except small population of Bactrian camels in central Asia. World Camel population is estimated to be around 25.89 million spread across 47 countries. Despite the camel's considerable contribution to food security in semi dry and dry zones, and its being a major component of the agro-pastoral systems in vast pastoral areas in Africa and Asia, little is known about its production potential and production systems compared to other domestic animals.

Camels are extremely important livestock species in the arid and semiarid zones in Asia and Africa. Camels contribute significantly to the livelihood of the pastoralists and agro-pastoralists living in the fragile environments (Abbas *et al.,* 2000; Tura *et al.*, 2010). The increasing human population pressure and declining per capita production of food in Africa precipitated an urgent need to develop previously marginal resources, such as the semi-arid and arid rangelands, and to optimize their utilization through appropriate livestock production systems among which camel production is certainly the most suitable (Schwartz and Dioli, 1992; Getahun and Kassa, 2002; Wardeh, 2004; Mehari *et al*., 2007).

In Ethiopia, camels are a subset of large livestock resource with a population of 2.3 million (CSA, 2004). But it is also worthy to mention that, there is regular inter boundary movement by the pastoralist between the neighbouring countries, states and zones with their livestock in search of water and grazing land, and hence the estimation of livestock should be treated with caution at national level. The Ethiopian dromedaries are found in south eastern and north eastern arid as well as semiarid regions, such as Somali, Afar, and Borana. The Somali, Afar, and Borana are the main ethnic groups involved in camel husbandry in Ethiopia. (Schwartz, 1992).

Camel production could be a profitable venture for utilizing the vast arid and semiarid areas of Ethiopia where other animals thrive with difficulty, especially due to the recurring drought conditions. Dromedaries are believed to have reduced fertility compared to other domestic species due to many factors, but one of the most

important is reproductive efficiency. Full exploitation of camels for milk and meat production would only be possible when their reproductive performance is properly understood and improved (Faye, 2005; Kaufmann, 2005; Skidmore, 2005; Kalla *et al.*, 2008; Hermas, 2009). The importance of maintenance of high levels of reproduction in camel is not only for profitable production but also to provide ample opportunities for selection and genetic improvement. The reproductive performance of camel depends on the genetic potential of the species and breed, the management and the production conditions (Kaufmann, 2005).

Interest in the camel's reproductive processes only began when its economic benefits became apparent (Yagil, 2006). The reproductive efficiency of camel under natural pastoral conditions is low, due to short breeding season, late age of puberty and long gestation period (13 months) (El-Hassanein, 2003; Skidmore, 2005). Other factors contributing to low fertility in camels include age at first calving, low libido of male thereby reducing breeding opportunities and late postpartum oestrus (El-Hassanein, 2003; Al-Qarawi, 2005). In addition, poor management practices in the regions where most camels are raised, adversely affect its reproduction and productive performance.

Information of camels in terms of productive and reproductive potentials in Ethiopia is very sparse. Few studies were conducted and almost all are more of to the production constraints and milk production aspects. Information on camel production systems and reproductive performance is almost absent. Therefore, the objectives of this research were to characterize camel production systems and evaluate the reproductive performances of camels at their natural pastoralist management systems of Somali region.

Materials and Methods

Study area description

The study was conducted in Jijiga Zone of the Somali Regional State (Figure 1). The Somali Regional State, which forms part of the Federal Democratic Republic of Ethiopia, is situated in the eastern part of the country at 4^0 to 11^0 North Latitude and 40^0 to 48^0 East Longitudes with a total area estimated to be around 325 thousand km^2 (MOARD-PADS, 2004). The topography of the Somali Region is mainly lowland, however, there are some spots that are relatively high. The altitude ranges between 500 and 1, 600 meters above sea level (m.a.s.l). The topography in Jijiga zone consists of complex features comprising of flat to gentle slope, hilly and mountainous. The average annual rainfall ranged from 300 mm to 500 mm and average monthly temperature ranges 16 to 20^0C (MOARD-PADS, 2004). Data collected from Jijiga for the period 1988 to 1998 indicate that areas with Jijiga terrain and its surroundings

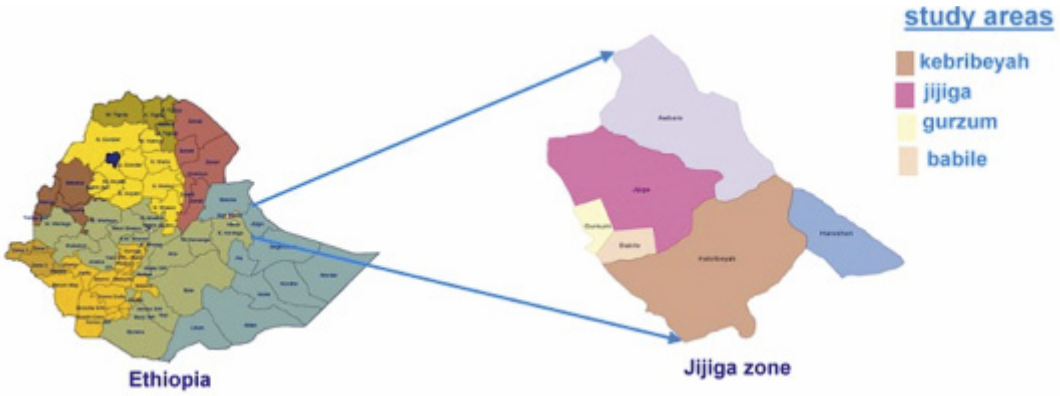

Figure 1 - Map of study districts in Jijiga Zone of Somali region (Source: http://www.reliefweb.int/map/ethiopia/administrative-regions-and-zones-thiopia.)

received annual rainfall that ranges from a minimum of 340 mm to a maximum of 627 mm, which averaged to about 500 mm per annum. Jijiga has a bi-modal rainfall pattern, usually occurring during the months of March to May and July to October (IPS, 2002).

Jijiga administrative zone is divided into three separate Food Economy Zones (FEZs), namely, sedentary agriculturalists, agro pastoralists and pastoralists. Agro-pastoralism is a dominant production system in Jijiga Zone (SCF-UK, 2001). Jijiga Zone comprises seven woredas namely Awbare, Dadamane, Gursum, Harshen, Jijiga, Kabribeyah and Tulli-Guled. Among these woredas, Dadamane, Gursum, Jijiga, Kabribeyah and Tulli-Guled were selected for conducting the study due to relative accessibility and camel population density purposively. The population in Jijiga Zone is mainly from Somali tribes which are Muslims and agro-pastoralists. Household size averages 6 and 5.3 heads in rural and urban areas, respectively. The zonal household size averages to 5.9, which is less than the average of 6.7 for the Somali Region (JZOA, 2001). This area represents the heartland of camel population of the country.

Study animals

Camels of the Jijiga zone of Somali regional state were the study population. The study animals considered in this research were 364 female camels and information about the reproductive parameters was collected using progeny history testing technique (Kaufmann, 2005). This method relies on the herders' intimate knowledge of their camels and long lasting memory of their life history. Physiological status (dry, lactating or pregnant) and previous breeding history of the herd were obtained by using the progeny history questionnaire. Age of the camels was determined by

examination of eruption of the permanent incisors and also most importantly by questioning of the herd owners. In almost all the cases our age determination coincided with the information from the owners. In cases of differences between the two techniques, dentition was determined as the owners sometimes might forget the ages of some camels.

Study design and data collection methodology

A cross sectional study design and set of detailed structured questionnaire were used to collect information from a total of 100 camel owners in different sites by guided interviews. Focused group discussion was the other approach to gather information about the production system and reproductive performances of camels among Somali pastoralists. The questionnaire was previously used in Sudan and Saudi Arabia and found to be effective for such studies (Algaylia and Mansour, 1998; Ishag and Ahmed, 2011) and adopted for the current research with some modification to fit in the Somali situation. Observational studies were also applied in the study areas in addition to historical information about the pastoral system and herd production collected from direct questioning of the pastoralists. Primary and secondary data were the sources of information used for the study. Primary data sources were the key informants during guided interviews and group discussion in the respective selected districts and the secondary data were collected from different regional, zonal and district level agriculture and pastoralist offices.

Purposive sampling procedure was implemented because of difficulty to apply random sampling due to the mobile, scattered and less accessible nature of pastoral communities. The household heads were selected based on camel possessions and willingness to be part of the survey. The method of data collection employed was a single-visit formal survey (ILCA, 1990). For group discussion, 15 camel breeders with long experience in camel rearing were selected from the 100 households and interviewed to gather reliable information on the production, adaptation and reproduction system variables. The questionnaire were designed to obtain information on general household characteristics, livestock and herd structure, herd management, breeding practices, disease prevalence, production objectives, feeding management and production constraints. Also information on the general composition of the herd, breed, age, sex, purpose of keeping camels, reproduction and production parameters were collected for this study.

The progeny history surveying technique used in this study was originally developed in Ethiopia by a team from the Ministry of Agriculture and has been used extensively by International Livestock Research Institute (ILRI) (Swift, 1981). For assessing animal production, the method has gained importance nearly during the last two decades and was used by Baumann and Zessin (1992), Scoones (1992) and

Kaufmann (2005) in order to collect data for calculating performance parameters of camels. It has found its entrance in advisory books on field data collection in livestock systems from International Institute for Environment and Development and Food and Agriculture Organization (IIED and FAO) (Catley, 2000).

The questionnaire included for the dam: her name, date of birth, acquisition (date, reason, location, age), breed, milk performance (good, average, poor), udder abnormalities, number of calves, occurrence of abortions and conception problems and current reproduction status. For every calf, date of birth, sex, and present whereabouts and reason for death or selling were recorded. In the progeny history questionnaire, the dates were specified by year and season and later converted into months for the sake of data analysis. The questionnaire was adapted from Kaufmann (2005) and the progeny history testing technique questionnaire is presented in the appendices.

The data generated for the dam were compared with the data collected separately for the single calves in order to see whether the information was consistent. Some inconsistent questionnaires were excluded from analysis. The main reproductive parameters considered include: age at first calving, calving interval, abortion rate, breeding life, numbers of services per calving, age at first service, gestation length, and other reproductive parameters.

Data analysis

The collected data were coded and entered in to Excel 2007 spread sheet for storage. The SPSS statistical computer software version 20 was used to analyze the data in descriptive statistics. Results were presented mainly in the form of narrations, tabular summaries and figures.

Results and Discussion

Somali pastoralists who have indigenous knowledge on camel reproductive performance and production system were interviewed. Major constraints on camel production, farming system and important reproductive performance parameters were studied during the research.

Demographic characteristics

In pastoral areas of the study sites education and health is very poor and most of the respondents in the study areas were illiterate (94%) whereas the remaining (6%) got only primary education of elementary schools (Grades 1-7). All the respondents were males since camels are only herded by males. The age of household head varied between 15 and 97 with mean age of 38.56±13.5 years.

Management system

Husband, sons and hired labourers were the main actors in camel management. Wives took part in camel management with husband and sons in milking, feeding, housing and marketing. Women are not allowed to herd camels since it is a difficult work and camels browse until night time which will cause a risk if women keep camels. In the recent time, hired labourers are increasing their numbers in camel herding of Somali pastoral areas. Husband occupied the highest sharing in camel management followed by sons and hired labourers (Table1). This agrees with the study conducted in Afar by Simenew *et al.* (2013)

Type and number of livestock reared by Somali pastoralists

During the study it was found that camels, cattle, goats and sheep were the types of livestock reared by Somali pastoralists in the study districts (Figure 2). The findings of the present study on livestock composition and herd size are comparable with the studies of Mehari (2006), Eyassu (2009) and Ishag (2009). It was indicated that keeping different livestock species by pastoralists is beneficial to sustain the pastoral livelihood during the worsening impacts of drought (Desta and Coppock, 2002). Furthermore, the present study addressed camel herd composition in the area as indicated in the results section in which she camels and female calves dominate the camel herd composition and this is in agreement with that of Diallo (2000), Getahun and Kassa (2002), Darosa and Agab (2008), Megersa *et al.* (2008) and Al-Dahash (2009). She camels are more dominant in the herd to ensure effective breeding and food security through market exchange of livestock (especially small ruminants) (Yayneshet and

Table 1 - Labor distribution in camel management system among family members of Somali pastoralists of Jijiga Zone, Eastern Ethiopia (N=100).

Family members	Management Practices						
	Feeding	Milking	Breeding	Herding	Health care	Housing	Marketing
Husband	30	26	83	50	92	70	84
Wife	0	1	0	1	0	0	0
Son	16	7	3	12	3	5	1
Daughter	0	0	0	1	0	0	0
Hired labourers	2	0	0	10	0	0	0

N= number of household respondent included in the study

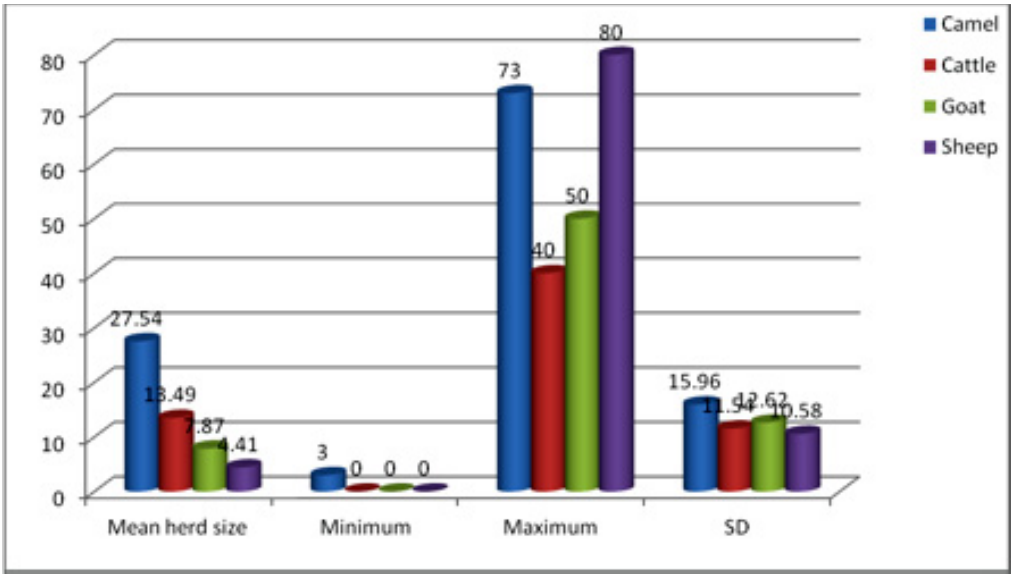

Figure 2 - Composition of livestock and herd size in Somali pastoralists Jijiga zone, Eastern Ethiopia.

Kelemework, 2004). Larger proportions of females in herds in the area indicate a strong desire of herdsmen to maximize herd size and the importance of camel milk production in pastoral areas. Slow rates of reproduction and long gestation intervals are also considered as factors that result in higher proportions of breeding females (Wilson, 1998). Somali pastoralists have indigenous knowledge to select the superior dams that give more female calves than males. The mean camel herd composition of the Somali pastoralists obtained in this study was comparable with that of Ishag (2009).

Relative importance of livestock among Somali pastoralists

Camel, cattle, goat and sheep are livestock species in the ranking order of their relative preference as shown in Figure 3. The majority of the respondents preferred camels as first rank over other livestock species followed by cattle, goat and sheep. Present study holds agreement with previous studies of Adugna and Aster (2004), in Dirre and Moyale districts of Borana zone in Oromia Regional State and in Moyale district of Liben zone in Somali Regional State in southern Ethiopia and Simenew *et al.* (2013) in Afar. In Somali pastoral area as is true in most of other pastoral systems camel was the best adapted animal because of its ability to resist drought and thirst by their special physiological and anatomical adaptation mechanisms over other domestic livestock species. Somali societies believe that camels are holy animals and

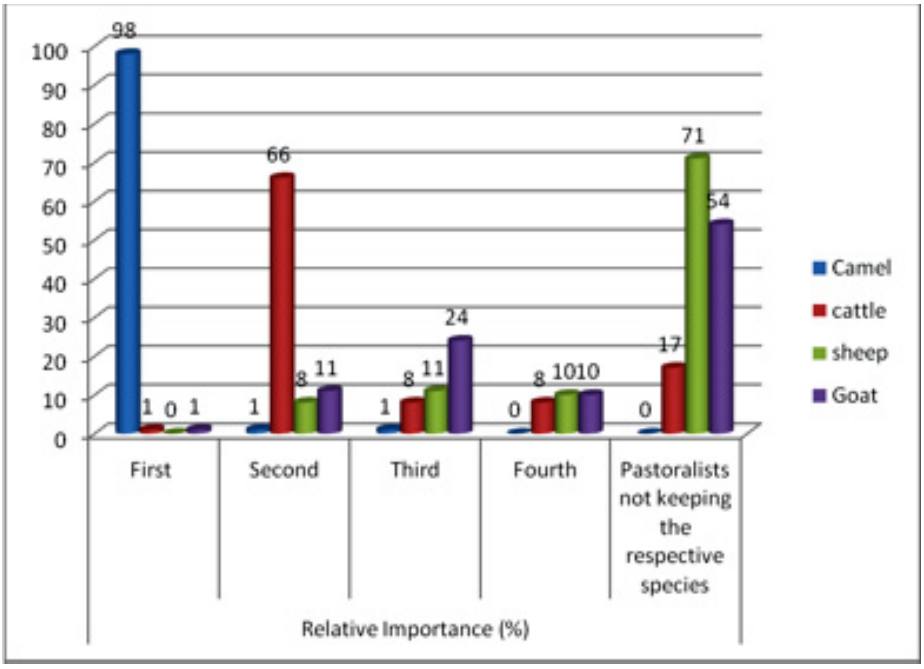

Figure 3 - Ranking of livestock among Somali pastoralists based on their relative importance in Jijiga Zone, Eastern Ethiopia.

can't be compared to other livestock. Camel is the only animal used to determine compensation for homicide, a lost eye, teeth, broken bones, and so on, depending on the circumstance and social status of the victim and the aggressor. According to respondents, the reasons they preferred camels over other livestock species were; tolerant to drought and to feed and water shortage, produce high amount of milk and meat, can be used as pack animal and can travel long distances.

Herd composition

Camel herd composition in the study areas are presented with their respective proportions in Figure 4.

Camel management system and migration trends of households with their camel herd

Traditional nomadic and transhumance management system accounted for 95% and only 5% of them were sedentary pastoralists in the study area. Camels were taken to mountain areas during wet season and to valleys, where pasture is available during dry season. Camels in the study area move to different places in different seasons.

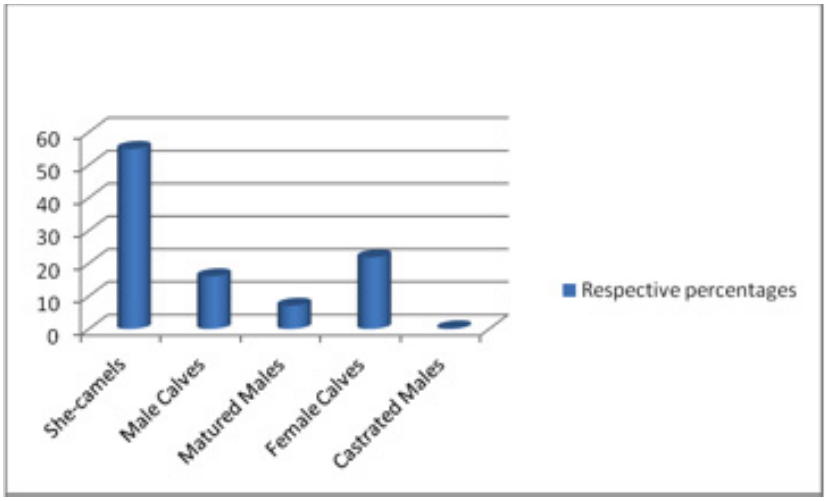

Figure 4 - Camel herd composition in Somali pastoralists of Jijiga zone of Eastern Ethiopia.

During wet season, camels were taken to mountain areas (91%) where there is no tick infestation and flies to prevent tick borne diseases and foot wounds whereas (9%) of the pastoralists took their camels where ever there is a good pasture. During dry season pastoralists move their camels to valleys (93%) where they can get cactus (*Opontiaficus-indica)* and water for their camels and the remaining 7% took where ever pasture is available. This finding is in agreement with that of Elmi (1989), Mehari (2006) and Simenew *et al.* (2013). Tezera (1998) stated that the households of Abasgul and Bertire clans in Jijiga move between Kebribeyah through Jijiga highlands of Fafen areas. According to the respondents, the main reasons for migration were for search of forage, water, and salt. Pastoralists complained that nowadays there is no migration to far distance to get enough feed for their camels due to security and restriction of livestock movement to the neighboring regions. Jijiga zone being agro-pastoralist, the majority of the respondents reported that they practice crop-livestock farming system (58%) and 42% only livestock rearing. This finding is comparable with the study of Ishag (2009) who stated that camel herders in Gezira (Sudan) practice crop-livestock farming system (61.5%) and 38.5% only livestock rearing

Camel herd dynamics

Male camels were frequently sold in the study area for the last 12 months due to different reasons. The main reasons for selling as pastoralists mentioned were due to income, buying animal for replacement and disease. About 306 camels were died in the last 12 months due to diseases (291) and predators (13) (Table 2).

Table 2 - Camel herd dynamics in the last 12 months among Somali pastoralists of Jijiga Zone, Eastern Ethiopia.

CAMELS SOLD	N	(MEAN±SD)	PERCENTAGES (%)
Sex			
Male	49		67.1
Female	24		32.9
Total	73		100
Average age of selling (Years)		7.14±4.33	
Reasons to sell			
Income	44		60.3
To buy Replacement animals	21		28.8
Disease	8		11
Total	73		100
CAMELS BOUGHT			
Sex			
Male	24		33.8
Female	47		66.2
Total	71		100
Average age of buying (Years)		4.42±1.67	
CAMELS DIED			
Sex			
Male	124		40.5
Female	182		59.5
Total	306		100
Average age of death		4.55±3.77	
REASONS OF DEATH			
Diseases	291		82.4
Predators	13		3.7
Total	306		100

N=number of animals for every respective parameter included in the study, SD=Standard Deviation

The mean age of camels sold was 7.14±4.33 years. The reasons of selling camels were due to source of income (44%), to buy replacement animals (21%) and diseases (8%). Accordingly, number of deaths due to diseases and predator attacks were higher than those sold. This is in agreement with the study of Megersa *et al.* (2008). In this period, a total of 71 camels were also bought in the area, females (47) and males (24) with mean age of 4.42±1.67 years. According to the respondents, a total of 306 camels were died in the last 12 months composed of males (124) and females (182) due to

diseases (291) and predators (13). In case of predators herders reported that hyenas and lions prey their camels, but hyenas were the most dominant. The average age of dead camels' death was 4.55±3.77 years.

In very rare cases, female camels were sold and slaughtered otherwise they are kept in the herd until they die. The major reasons to cull female camels in the Somali society were diseases, old age and poor production performances. This result is in agreement with the findings of Simenew *et al.* (2013). Selling is the most common measure to cull female camels in Somali society but in Afar, slaughtering is more common than selling as indicated by Simenew *et al.* (2013).

Camel herd dynamics simulation

Herd dynamics simulation data were developed in order to estimate long-term herd development with the status quo parameters and with improved reproductive parameters for the Somali camel populations. Some hypothetical improvements were tested for age at first calving, calving interval and calf mortality rate. However, herd dynamics simulations were found to be difficult to calculate because of the difficulties in collecting important data for such analysis. Improvement of age at first calving and calving interval is conducted by excluding ages at first calving older than 60 months of age and calving intervals longer than 18 months from the data set resulted in a mean age at first calving and mean calving interval given in table 3. The exclusion age margins are not arbitrarily chosen, rather majority of the camels give birth every 18 months and they give their first birth at the age of 60 months from the data collected. Therefore, it is reasonable to set these months as age of possible improvement for the whole camel population in the study areas. Proper housing to prevent predation by itself improves calf mortality from 10.7% to 7%, and if other management measures like vaccination and good colostrums supplement might reduce calf mortality even better.

Breeding practices and reproductive performances

About 59% of camel herders kept only one breeding male and very few herders (8%) kept 3 breeding males. The sources of breeding camel in Somali pastoralist production systems were own herd, bought and other herd as indicated in table 4. The average age to select of breeding male camel in the present study was found to be 5.94 ± 0.81 years. The reproductive span of male breeding camels varied from 2-30 years. The male to female ratio in the study area was 1:13. Majority of camel owners use their own herds for replacement of the breeding male. This finding agrees with that of Ishag (2009). Camel owners who did not keep breeding male camels reported the small size of herd and death of breeding camel as the main reasons for absence of a breeding male camel. They were using bulls of their relatives, friends or mix their herds with

Table 3 - Mean age at first calving, calving interval and calf mortality rate of Somali camels in Jijiga Zone, Eastern Ethiopia.

	Reproductive parameters	Mean±SD (in months)	Percentage (%)
Status quo	Age at first calving	62.16±10.44	
	Calving interval	23.28±3.36	
	Calf mortality rate		10.7
Improved state	Age at first calving (> 60 months of age excluded)	57±5.52	
	Calving interval (>18 months excluded)	14.84±4.8	
	Calf mortality rate		7

SD=Standard Deviation

another herds with a good breeding male for free. According to respondents 59% of Somali pastoralists kept only one breeding male camel in their herd and very few with three breeding male camels. This agrees with the finding of Melaku and Gebreah (2001). The reasons that pastoralists keep only one bull as respondents reported were to avoid fighting and to get similar types of offspring with good performance. The results also revealed that the average number of breeding camels was 1.15 camels per herd. This finding agrees with previous studies of Mehari (2006), Ishag (2009) and Simenew *et al.* (2013). During rutting period, the breeding male camel will not allow other mature bull to be in the herd and acts as king of the herd by showing signs like gurgling sound, urine splashing, splayed stance, frothing of saliva and poll gland secretion. The rut male will not copulate if other mature males are present in the herd. The average age to select breeding male was 5.94±0.81years. This finding is higher than that reported in Afar by Simenew *et al.* (2013). This may be due to management system difference, the climate condition of the area and also camel breed differences between the two regions. Somali pastoralists select their breeding male camel by genetic and appearance. The selected breeding male camel was not used for any purpose other than breeding. The average age of keeping breeding male camels in the herd in the study area was 11.81±5.03 years. This is in agreement with the reports of Ishag (2009) and Simenew *et al.* (2013).

Production performances

Daily milk yield of Somali camels range from 1-20 litres per day depending on feed availability, season and water access as indicated in table 5.

Table 4 - Breeding male camel reproductive performances in Somali pastoralists of Jijiga zone, Eastern Ethiopia.

STATISTICS AND FREQUENCY OF BREEDING MALE PERFORMANCES		(MEAN± SD)	MINIMUM	MAXIMUM	PERCENTAGES (%)
Number of breeding male		1.15± 0.8	0	3	
Source of breeding male	Own herd				69
	Bought				14
	Other herd				17
Age to select breeding males (Years)		5.94± 0.81	2	8	
Service year of breeding males (Years)		11.81± 5.03	2	30	
Farmers get service from the breeding male currently		1.26± 1.41	0	6	
She camels mated by the breeding male currently		14.99± 22.25	0	100	
Farmers got service from the breeding male last year		1.65± 3.64	0	30	
She camels mated by the breeding male last year		20.56± 33.79	0	200	
Pregnancy rate after last year mating by the breeding male					62.8

SD=Standard Deviation

Camel production objectives among Somali pastoralists

Milk and meat production were the main objectives of keeping camels in Somali pastoralists (100%). Animal sale, traction, insurance and investment were also mentioned to be objectives of keeping camel by the pastoralists.

Main constraints in Somali camel production

The main constraints of Somali camel production mentioned in the study area were diseases, lack of pasture, security and lack of capital (Figure 5). The most prevalent diseases in the study area were Camel pox (51%), anthrax (29%), trypanosomiasis (10%) and respiratory diseases (4%). Respondents reported that since there is feed shortage in the area the only main feed which camels feed during dry season was cactus which caused mortality and poor production for the camels. Respondents mentioned that there will be no more camels in the area after 10 years due to cactus

Table 5 - Productive and reproductive performance of Somali camels under their pastoral production system of Jijiga Zone, Eastern Ethiopia.

PRODUCTION AND REPRODUCTIVE PERFORMANCES	N	MINIMUM	MAXIMUM	(MEAN±SD)
Age at First Service (months)	100	48	84	52.56±7.56
Age at first calving (months)	100	48	108	62.16±10.44
Calving interval (months)	100	1	72	23.28±3.36
Gestation Length (months)	100	12	13	12.43±0.5
Longevity (years)	100	7	30	18.49±5.45
Number of calves	100	4	16	9.17±2.67
Number of services	171	1	10	1.84±1.32
Milk yield at the start of lactation (Litre)	364	1	12	4.40±2.01
Milk yield at the middle of lactation (Litre)	364	1	20	3.81±2.31
Milk yield at the end of lactation (Litre)	364	1	6	1.68±0.92
Lactation length (months)	364	6	24	11.51±1.91

N=total number of camels included as part of the study for the respective parameters listed and SD=Standard Deviation

and hyenas if intervention measures are not implemented. In addition to the above main problems for the Somali pastoralists, lack of veterinary services, lack of governmental or private drug stores and lack of professionals support towards improvements of production and productivity of their camels were also reported.
In very rare cases old, infertile and sick female camels are sold and slaughtered otherwise they are kept in the herd until they die. The major reasons to cull female camels in the Somali society include; diseases (30%), old age (41.4%) and poor production performances (28.6%) with 99% of culling measures accounted for selling.

Diseases of camels affecting reproductive performances

Diseases were picked as the major hindrance of camel reproductive performances in the study area. The major diseases that affect camel reproductive performances according to their relative importance were reported by the respondents as indicated on figure 6.
Female camels are the core of the herd composition in Somali pastoralists since the main livelihood of the people depend on camel milk production. The main source of breeding female camels of Somali society was either own herd or bought (Table 6). The major types of camel breeds listed by the respondents were Cagwayn (47%), Ayun (19%), Geelcad (14%), Aydin (12%), Geelab (5 %) and Hoor (3%).
The pregnancy rate after last year mating by breeding male was 62.8%. The average daily milk yield in the area fairly agrees with the studies of Kedija *et al.* (2008) but

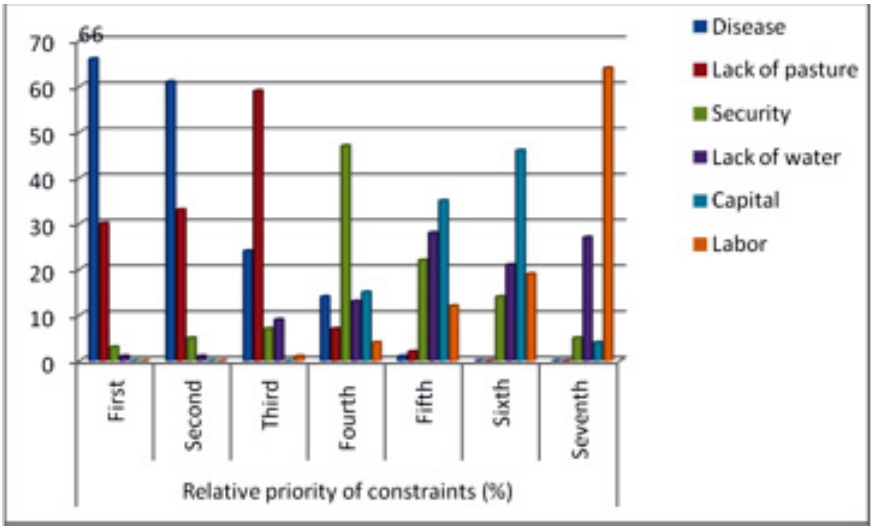

Figure 5 - Production constraints of camel rearing in Jijiga Zone of Somali region, Eastern Ethiopia

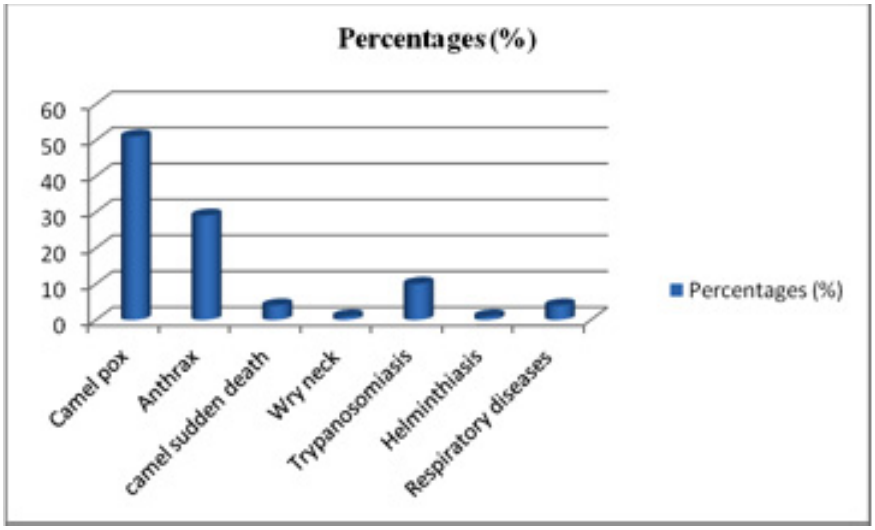

Figure 6 - Diseases affecting reproductive performances of camels in Jijiga Zone, Eastern Ethiopia
Reproductive performances of Somali female camels.

lower than that of Mehari (2006); Ishag (2009) and Simenew *et al.* (2013). The average low daily milk yield result found in this study may be due to feed shortage in the area, breed difference or the early breeding practices done after parturition. The report of Ahmed et al. (2005) indicated that the breeding practices of camels after parturition

in Ethiopia is mostly done after they complete 300-365 days of lactation. The mean lactation length of present study was 11.51±1.91 months is in agreement with the studies of Tezera (1998), Alemayehu (2001), Kedija (2007), Mehari *et al.* (2007), Eisa and Mustafa (2011), Ishag and Ahmed (2011), and Simenew *et al.* (2013).
The average age of first service of the present study agrees with previous studies of Adugna and Aster (2004), Mehari (2006) in Babile and Kabribeyah of Jijiga zone and Babiker (2010) in Sudan. Average age at first calving was found to be 5.18±0.87 years with a range of 4-9 years and calving interval was 1.94±0.28 years comparable with previous reports (Melaku and Gebreah, 2001; Ahmed *et al.*, 2005, Kaufmann, 2005; Kedija, 2007; Simenew *et al.,* 2013). In Somalia, Farah et al. (2004) reported that calving interval for Somalia camel was 27.4 ± 9.3 months which is higher than the Ethiopian camel. The average number of service per conception was 1.84±1.32 which is in line with the studies of Melaku and Gebreah (2001) and Simenew *et al.* (2013). The reproductive span of Somali female camels was between 7-30 years with average calves of 9.17±2.67. This finding is in agreement with those of Schwartz (1992), Ahmed (1993), and Yagil (1994) who stated that the breeding life of female camels was between 25-30 years. The ratio of male to female in a breeding herd was found to be 1:13. Elmi (1989) reported the ratio of male to female camel in Somali to be 1:11. The main sources of breeding female camels of Somali society were either own herd or bought and the average age of breeding female camels was 11.76±4.26 years. The major types of camel breeds listed by the respondents were Cagwayn, Ayun, Geelcad, Aydin, Geelab and Hoor. The present study is in agreement with that of SORPARI (2011). High abortion rate (81%) and low udder abnormalities (13%) have been reported. Lactating females were the most dominant in the herd (66%) and 97% of the breeding females had no problem in conception. The present study revealed that mean age of the calves was 3.61±2.71 years. About 10.7 % of calves died before reaching weaning age. This finding agrees with the studies of Kaufmann, (1998) and Njanja, (2007) in Kenya.

Camel calves data of Somali pastoralists

About 10.7 % of calves were died before reaching weaning age due to the high disease prevalence in the area. Most of the time calves are kept in the herd but sometimes Somali pastoralists dispose their calves due to income, gift for praying and gift for marriage (Table 7).
According to key informants focused group discussion, the major feed types found in the study areas were Barkakati (*Lantana camara)*, Iswadhwadh (*Acacia brevispica*) and Adad (*Acacia senegal*). In addition to these feeds, cactus (*Opontiaficus-indica*) was the major camel feed during dry season which caused ulcerative lesions. The key informants reported that there are two types of cactus in the area; cactus with long

Table 6 - Sources, milk yield performances, presence of reproductive problems and Physiological status of Somali female camels during the study period in Jijiga Zone of Eastern Ethiopia.

	(Mean±SD)	Minimum	Maximum	Percentages (%)
Source of breeding female				
Own herd				82
bought				18
Age of breeding female (years)	11.76±4.26	5	26	
Milk yield performances				
Good				84
Average				16
Poor				0
Udder abnormalities rate				
Normal				87
Abnormal				13
Number of calves	3.78±1.83	1	10	
Abortion Experience rate				
Have experienced at least once				81
No abortion history				19
Time of abortion				
Early				9
Late				9
Both				1
Conception problem rate				
Have conception problem at least once				3
No conception problem history				97
Physiological state				
Lactating				66
Pregnant				32
Both				2

SD=Standard Deviation

spines and cactus with tiny spines. The later is the most dangerous for camel. Feed or water was found to be a problem during dry season (January-April). Camel pox, trypanosomiasis, calf scours and respiratory diseases were the most common diseases. Major camel reproductive problems reported by the group were abortion, still birth, uterine prolapse, retained foetal membrane, dystocia and endometritis.

Conclusion

Traditional nomadic, is the main type of management system practiced by Somali

Table 7 - Camel calves data of Somali pastoralists using progeny history testing in Jijiga zone, Eastern Ethiopia.

Calves information	(Mean±SD)	Minimum	Maximum	Percentages (%)
Age	3.61±2.71	1	15	
Sex				
Male				42.1
Female				57.9
Weaning age				
Reached at weaning age				89.3
Died before weaning age				10.7
Age of death (Years)	2.09±2.18	1	13	
Reason of death				
Diseases				92.2
Predators				7.8
Where about of the calf				
In the herd				78.7
Died				15.5
Sold				3.7
Aborted				1.6
Slaughtered				0.5
Age of disposal (Years)	7.13±2.33	3	10	
Reason of disposal				
Income				73.3
Gift for praying				20
Gift for marriage				6.7

SD=Standard Deviation

pastoralists of the study areas. Camel, cattle, goat and sheep were the main types of livestock reared in the area with high preference of camels over other livestock. She camels were dominant in the herd followed by female calves. Participation of hired labourers in camel management is increasing from time to time in the study areas and this might favour for the children of the pastoralists opt for education. Disease, feed shortage and security were the main constraints of camel production in Somali pastoralists. Camel pox, anthrax, trypanosomiasis and respiratory diseases were the most prevalent diseases in the study districts of Somali pastoralists. Cactus and predators were also the emerging challenges for camel owners in the study areas as a consequent of drought. Female camels were very rarely culled due to diseases, old age and poor production and reproductive performances. Inbreeding might be an unnoticed problem for the camel owners of the areas as they use only one breeding male for several years with same pedigree to specific camel herd. Generally, the

reproductive performances of the Somali camel breeds seem to be lower. High abortion rate was recorded and more calves died before reaching weaning age. Extensive study to evaluate the reproductive and production performances of camel breeds of the country should be conducted to select the most productive breeds for specific purposes. Regular training for real pastoralists and development agents on proper management of calves, lactating and pregnant camels, disease prevention, control, surveillance and reporting system to the respective bodies should be devised.

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