

A Socio-Economic Impact of Camel Sudden Death in Borana Zone; Oromia Regional State, Southern Ethiopia

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Abstract: A Questionnaire survey was conducted in two districts of Borana rangeland starting from November 2015 to March 2016 to assess indigenous knowledge on camel disease prevention, control and the associated socio-economic impacts of camel sudden death in 2013/2014. A total of 130 camel owners from two districts of Borana zone were randomly selected and interviewed. Of the interviewed 54 of them suffered from at least one camel sudden death. The sudden camel mortality was highest in lactating, breeding and heifer camels and did not manifest any clinical signs. The mean (\pm standard deviation) financial loss associated with dead camels is about 13, 659 \pm 6617birr. The pastoralists reported that respiratory-related diseases are major camel disease in the study area followed by trypanosomosis. Further research that targets the identification of the etiological agents of sudden camel death and respiratory symptoms and the critical evaluation of the sudden camel death should be undergone.

Key words: Mortality • Respiratory Disease Complex • Questionnaire Survey

INTRODUCTION

There has been a trend of growing numbers of camels in the world between 2001 and 2011, FAO [1]. This increase might be attributed to their adaptation to various environments, development in camel farming and an improved ecological image of camel farming and products. The total population of camels in the world in 2013 was estimated to be around 25 million animals. This number is probably underestimated because camels are migrant animals. It is difficult to conduct a census for camels such as the wild Australian camel population. The general estimate of the camel world population may probably be around 30 million head [2].

In Ethiopia, camels represent a subset of major livestock resources with a population estimated at >2.3 million. The major ethnic groups owning camels in Ethiopia are the Afar, Somali and Borana [3]. However, despite its significant contribution to the livelihood of the pastoralist society who does have a little alternative mode of the production system, up until recently the camel is one of the neglected domestic livestock by the scientific community in Ethiopia [4].

Unique anatomical and physiological characteristics of camels enable them to exist, reproduce and produce meat and milk during periods of drought, poor grazing and low management. Camels possess a height advantage over other livestock. Camels can browse at 3.5 m above the ground, thus, they compete only with the giraffe for browse. This characteristic makes them excellent for multi-species herds composed of low browsing goats and grazing sheep and cattle [5]. Camels possess a fatty hump that is used for maintenance when grazing is poor. Heavy keratinized, prehensile lips that are split and long incisors that allow browsing of thorny vegetation not utilized by other livestock and wildlife are advantageous because much of the Sub-Saharan browse is composed of thorny species like Acacia [6].

Climate changes have effects on camel stocks and breeding and on their geographical distribution, health status and social use by the farmers. The impact of climate change on camel health could be summarized in three ways; these are, direct effects caused by heat stress for example, leading to over-mortality, indirect effects as a result of more favorable conditions for microbes to develop and indirect effects on the adaptation

mechanisms of camels facing resource and/or water shortage [7]. The high health constraints in camel farming are well known and have been listed for a long time under the main classical diseases such as trypanosomosis, mange, camelpox or gastro-intestinal parasitism [8].

Camels have been formerly regarded as hardy animals and less susceptible to most of the diseases that affect other livestock species sharing the same eco-zones. However, recent advances in camel research have revealed that camels are found to be susceptible to a large number of pathogenic agents, some of which are still unknown [9]. Regardless of the efforts made in scientific research, much of camel health problems remain mysterious and sudden deaths of camels in countries of Northern and Eastern Africa, as well as the Middle East, have been puzzling the scientific community [10].

A new epidemic of camel disease of unknown etiology has been plaguing the camel population in Ethiopia since 1995/1996, with reports of its occurrence in neighboring countries like Djibouti, Sudan, Eritrea, Somalia and Kenya [11]. The disease was highly acute and contagious and affected all camel populations across the country [11, 12]. A reoccurrence of the epidemic was first reported from Fantale district of Oromia in November 2004, causing the death of 148 camels with gradual propagation to Eastern Oromia (172 camel deaths), Afar (350 deaths) and Somale regions of Ethiopia in 2005/2006, Bekele [13]. A similar epidemic has claimed several deaths in 2006 in Somalia with further extension to northern Kenya and Borana areas of southern Ethiopia in 2007, Gluecks and Younan [14], Dawo [15].

The sudden camel mortality that affected pastoral areas of southern Oromia in 2007 killed a large number of pregnant and lactating females [15]. Similar mortality in female camels during drought periods was reported from Southern Ethiopia in 2000, Ndikumana *et al.* [16]. The high mortality in both pregnant and lactating camels has a direct negative effect on the livelihood of pastoralists because a pastoralists 'depend on milk from their animals [15]. According to report by Megersa *et al.* [17], 75% of camel milk from this area is used for home consumption and the rest for the generation of cash income for household expenditure. The economic losses associated with death of breeding females and consequent impacts on social welfare and household food security have considerable connotations. Using local market price, Dawo [15] has attempted to estimate the economic losses to be averaged at 2, 377.60 Birr (264 USD) per animal. Indeed, death of pregnant or lactating camels, in addition

to direct economic loss, adversely affects the replacement of stock, direct cash income and food supply for households, as major share of the camel herding household food comes from camel milk.

Hence, the objectives of the study were:

- To investigate socio-economic impact of sudden camel death.

MATERIALS AND METHODS

Study Area Description: The study was conducted from November 2015 to March 2016 at Yabello and Moyale districts of Borana Pastoral area of Ethiopia that are located at 565 and 766 kilometers far from the capital Addis Ababa, respectively. The Borana zone has predominantly a semi-arid climate. The annual temperature varying between 21°C and 38°C with little seasonal variations and rainfall ranges from 350mm to 900mm, with considerable spatial and temporal variability in quantities and distribution [18]. The zone is characterized by bimodal rain with 60% occurring in the long rainy season (*Gana*) extending from mid-March to May and erratic short rain season (*Hagayaa*) from mid-September through mid-November. The other two seasons are the cool dry (*Adolessa*) extending from June to August and the major dry season (*Bonna*) from December to February [19].

The Borana plateau of 95, 000 km² gently slopes from high mountain massifs in the north (1650 meter above sea level (m.a.s.l)) to the south bordering Kenya (1000 m.a.s.l) with a slight variation due to central mountain ranges and scattered volcanic cones and craters [20].

The largest proportion of the Borana zone (62.5%) can be classified as lowlands with a semi-arid to arid climate. Nomadism and semi-sedentarism are typical livestock-rearing practices in these areas. Animal husbandry in the area is characterized by extensive pastoral productions system and seasonal mobility. As aridity increases, the principal stock shifts gradually from cattle combined with small stock to camels combined with small stock with a relative degree of the social and cultural values accounting for differences. Camel herd movement may move the whole herd to water points and to relatively better areas where green fodder is available, or by herd splitting where lactating and young animals are kept around homesteads and moving the rest to distant located forage areas [21].

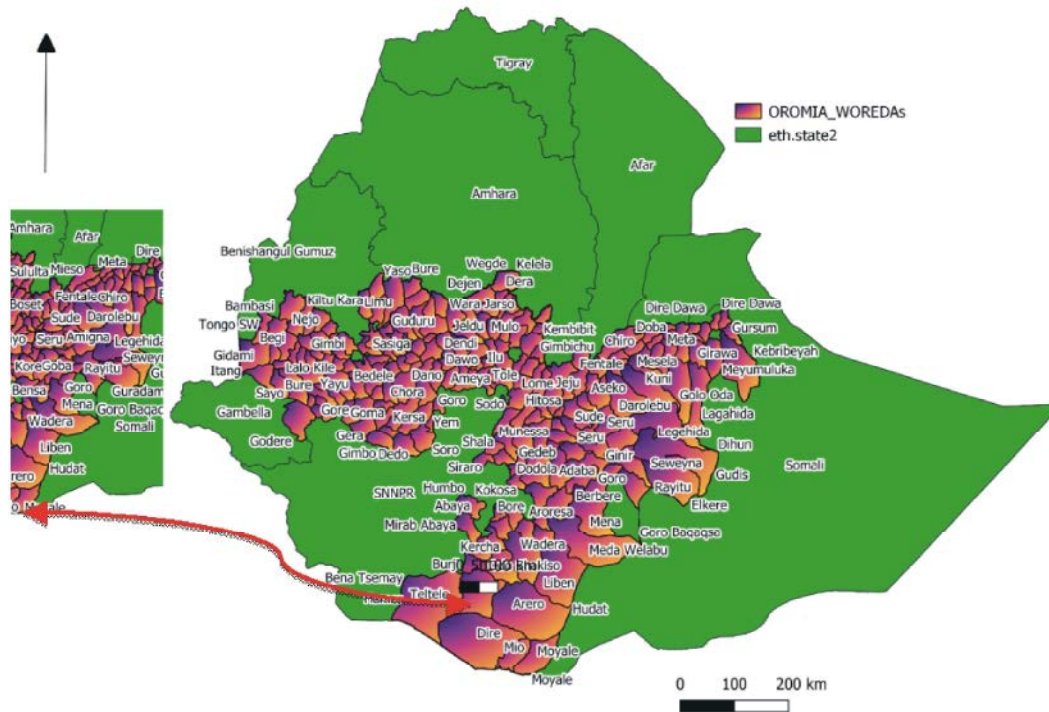


Fig. 1: Map of the study area designed by QGIS 3.4

Study Districts: Two districts were purposely selected for the study because of accessibility.

Yabelo: Yabelo is one of the districts in the Borana zone of Oromia Region, Ethiopia. Yabelo is bordered on the south by Dire, on the west by Teltele, on the north by Bule Hora (Hagere Mariam) and on the east by Arero. This town has a latitude and longitude of 4°53'N38°5'E and an elevation of 1857 meters above sea level. It is administrative center of the Borana Zone since its division from Guji Zone in September 2002 and located at distance of 565 km Southern of Addis Ababa [22].

Moyale: Moyale is one of the woredas in the Borana Zone of Oromia Region, Ethiopia. It is located in the southeast corner of the Borana Zone. Moyale is bordered on the south by Kenya, on the west by Dire, on the northwest by Arero, on the north by the Dawa River which separates it from Liben and on the east by the Somali Region. The altitude of this woreda ranges from 1150 to 1350 meters above sea level and located at a distance of 766 km from Addis Ababa. A survey of the land in this woreda shows that 9% is arable, 60% pasture, 21% forest and the remaining 10% is considered swampy, degraded or otherwise unusable. Cereals cultivated include corn, wheat, teff, barley and sorghum; sugar cane, banana and papaya are other important crops [22].

Study Design: Camel owners in the two selected districts of Borana zone were interviewed using structured questionnaire. The questionnaire consists of questions related to indigenous knowledge on disease prevention and controls as well as socio-economic impacts of camel sudden death. A total of 130 camel owners from two selected districts of Borana zone were randomly selected and interviewed.

Data Collections and Analysis: Data in the study area was collected by direct interviewing of camel owners to share their indigenous knowledge on disease prevention and control and who suffered from camel sudden death in 2013/2014. Because of inaccessibility of many remote areas as well as shortage of transportation facilities, the formal sampling procedure was very difficult. Only those individuals were interviewed at market places, at watering points, meeting sites and around their settlement camps. A total of 130 camel owners were interviewed of which 65 individuals were from Moyle and 65 from Yabelo districts. Camel owners were asked to relate disease signs with local disease names, to point out whether they have access to modern veterinary service or/and whether they use traditional treatment measure they take to prevent and control different camel diseases. Camel owners were also interviewed if they suffer from camel sudden death and those incidents who suffered from camel sudden death

were asked if they know the causes of camel sudden death, any clinical signs immediately before and during death and post-mortem findings (if any). In addition, the estimated price of the milk loss among lactating camels and price of camels that is dead calves, heifer, dry camels, lactating camels and bull were collected based on the market situation in the area when the camel deaths occurred.

The data collected through questionnaire survey was then entered to Microsoft Excel spreadsheet. The data analysis was conducted using MINITAB statistical software v.16. Descriptive analyses for proportion or frequency of respondents were used to summarize the data.

RESULTS

Knowledge of Camel Owners on Prevention and Control of Camel Disease: A total of 16 camel diseases and/or symptoms were reported by pastoralists that need to be controlled and prevented in the two study areas. Table 1 summarizes the local names of the major camel diseases and/or symptoms, their equivalent English names and the corresponding proportions. The table shows that Furi (Camel respiratory disease complex) accounts for the highest percentage (73.08%) of the camel diseases reported by pastoralists followed by Trypanosomiasis (63.85%). Abscess and lymphadenitis account for 62.02% and 60%, respectively.

Table 1: Major camel disease/symptoms reported by Borana pastoralists

Disease or symptom	Equivalent English name#	Number of respondents	Total respondents	Sample Proportion (%)	95% CI
Furi	Camel respiratory disease complex	95	130	73.08	(0.645955, 0.804765)
Dhula	Contagious skin necrosis	13	130	10	(0.054329, 0.164932)
Kanicha	Lymphadenitis	78	130	60	(0.510456, 0.684882)
Dhukana	Trypanosomiasis	83	130	63.85	(0.549611, 0.720850)
Mala	Abscess	80	130	62.02	(0.530542, 0.704119)
Baga	Camel pox	22	130	16.92	(0.109201, 0.244931)
Udanki	Wry neck syndrome	36	130	27.69	(0.202085, 0.362214)
Lukmura	Myositis	31	130	23.85	(0.168134, 0.321079)
Dhuguda	Chronic coughing	54	130	41.54	(0.329656, 0.505057)
Citoo	Mange	17	130	13.08	(0.078060, 0.201101)
Dhidhisi	Joint ill and septicemia	8	130	6.15	(0.026940, 0.117655)
Chachabsa	Hypocalcaemia	13	130	10	(0.054329, 0.164932)
Elgofo	Chronic wasting disease	1	130	0.77	(0.000195, 0.042113)
Sattawwa	Neck and shoulder paralysis	10	130	7.75	(0.037799, 0.137941)
Amburur	Camel contagious ecthyma	4	130	3.08	(0.008446, 0.076907)
Guro	Otitis	5	130	3.85	(0.012604, 0.087474)

#The equivalent English names were obtained from Megersa (2010)

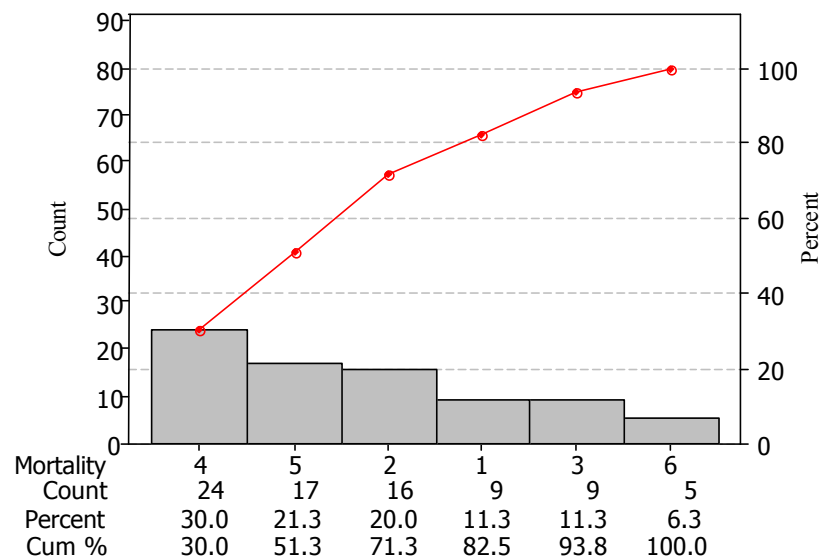


Fig. 2: Groups of camels affected by the sudden mortality in 2013 and 2014. 1 -Calves (<1year of age), 2- Heifer, 3- Pregnant, 4- Lactating, 5-Breeding bull and 6- Dry

Table 2: Descriptive statistics for market price of dead camels, milk yield and milk price per litter

Variable	Mean	St.dev	Minimum	Maximum	Range
Market price of died camel	13, 659	6, 617	2, 000	30, 000	28, 000
Milk yield/camel (lt)/ day	6.04	1.65	4	10	6
Milk price per litter	13.12	1.62	10	15	5
Total milk price/camel	79.25	23.97	45	150	105

St.dev- standard deviation; lt- litre; / - per. All prices are in Ethiopian Birr

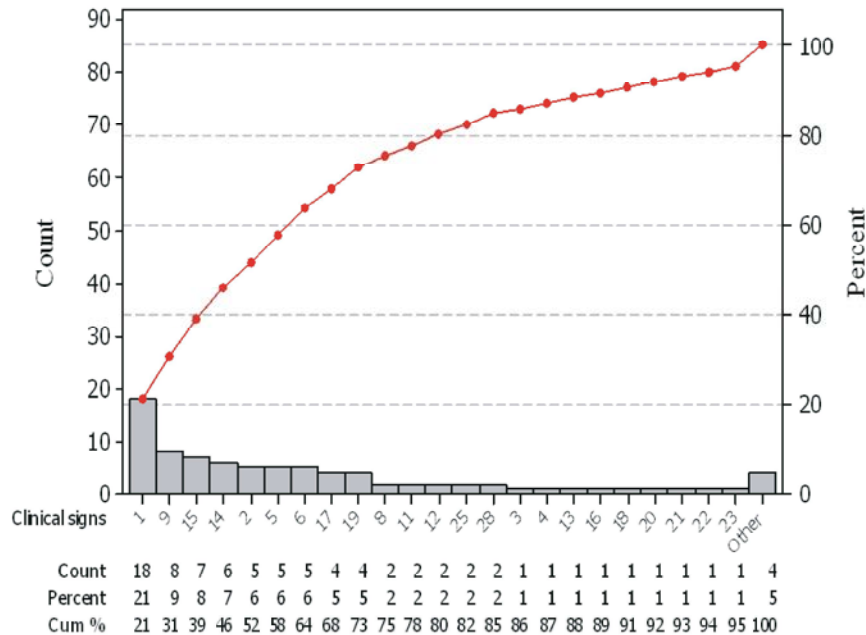


Fig. 3: Major clinical signs and associated symptoms of camel sudden death reported by pastoralists

Socioeconomic Impacts of Camel Sudden Death:

According to the pastoralists, the sudden camel mortality affected camels of all age and sex groups. Of the sudden camel mortality affected camels, lactating (30%) and breeding bulls (21.3%) were found to be the most affected camels. Summary of the affected groups of camels by the sudden camel mortality is indicated in Figure 2. According to the Figure 2, about 51% of the sudden deaths were reported in lactating camels and breeding bulls followed by heifers.

In monetary terms, the financial loss due to sudden camel mortality on average is 13, 659 birr ± 6617 birr (mean ± SD; minimum and maximum 2000 birr and 30000 birr, respectively) which is equivalent to 663.7USD (\$) per camel (1\$ =20.58birr). In lactating camels, the mean (± SD) milk yield was 6.04 ± 1.65litter (lt) per camel per day and the price of milk per lt was 13.12 birr (± 1.61 birr; range 10 to 15birr).

A wide range of clinical signs were reported by pastoralists in affected camels but about 21% of the respondents reported that the sudden camel mortality was per acute and clinical signs were difficult to obtain. The survey result also showed that most camel sudden

mortality were observed after camels suddenly fall down while grazing and being milked, or found dead. In all these three cases, no clear clinical signs were observed because the sudden camel death did not give enough time for clinical sign development.

The red colored line in the graph shows % cumulative values. Number referring to clinical signs were defined as follows: 1- fall down while grazing, milking, 2- observed after death, 3-depression, swelling of the head, 4-swelling around the eye, lacrimation, 5-swelling around the neck area, coughing, 6-Nasal discharge, coughing, 8-diarria , difficulty of urination. 9-Depression, unable to stand and then died, 11-open mouth coughing, after opening the body enlarged emphysematous lung, 12-Swelling around the birth canal, 13-Enlargement of udder, depression 14-bent neck , aimless movement, 15- swelling under the abdomen, dyspnea, 16-Restless, hate inanimate object, 17-depression, after opening the body hemorrhagic enteritis , 18- Stiff neck and tail, 19-Swelling of lymph nodes, 20-Nerves nous 21- Distension of abdomen, salivation, 22-Bellowing, straining 23-Salivation, nasal discharge, 25-head and ear shaking 28-ventral edematous swellings, self kicking.

DISCUSSION

Camels are important animal species for the livelihood of pastoralists in that they are the only known animal species that can tolerate hard environmental conditions and produce milk and meat during drought seasons. Although they are such crucial animals, they suffer from many known and unknown diseases e.g. sudden camel mortality observed in Ethiopia [15] for which the etiological agent is unknown so far. Approximately, 51% of the sudden camel mortality reported by pastoralists in this study affected lactating and breeding bulls. This partly agrees with the previous report in that the 2007 sudden camel death in the Borana pastoral area affected lactating and pregnant camels [15, 23]. This suggests that the disease is targeting physiologically active camel age groups including lactating, pregnant and breeding bulls as reported previously. The role of such physiological status on sudden camel mortality is not known and need to be investigated in the future. This was complicated with absence of any clinical sign before death of the camels.

The average financial loss of the dead camels ($13,659 \pm 6617$ birr (mean \pm SD in birr)) was direct loss as a result of the camel mortality. The other additional costs observed include loss of milk, loss of replacement stock due to death of pregnant cows, livelihood impact of such mortality on the camel owners etc that needs careful economic analysis of both direct and indirect financial losses.

In order to overcome the camel health problem, Borana pastoralists were known to use veterinary clinic in their area and also use their indigenous knowledge that was passed from generation to generation.

CONCLUSION AND RECOMMENDATIONS

An unusually high number of camel deaths were reported since 2005 in Ethiopia including neighboring countries like Somalia and Kenya. The sudden camel mortality mainly affected lactating camels and breeding bulls without any prior symptoms. The questionnaire survey result of the study revealed that the disease affected physiologically active camels compared to calves and young camels. The high financial losses associated with the dead camels and associated economic losses have serious impacts on social welfare and household food security. Based on the above conclusion, the following recommendations were forwarded: The etiology and risk factors associated with camel sudden death should be studied in more detail. The socioeconomic

impacts associated with camel sudden death should be well estimated and those pastoralists who lost their camels should be supported in the form of compensation by the government or NGOs operating in the area so that their livelihood will not be affected. Documentation and conservation of indigenous knowledge should be practiced. Information exchange and education at all levels are needed to increase the awareness of indigenous knowledge. Local communities should be encouraged to involve in the conservation, cultivation and marketing of medicinal plants.

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REFERENCES

1. FAO, 2013. Food and Agriculture Organization of the United Nations Statistics Division. Available at <http://faostat3.fao.org/faostat-gateway/go/to/home/E>.(Verified 6 Aug. 2014).
2. Faye, B., 2013. Camel Meat in the World, In Camel Meat and Meat Products. Eds.I.T.Kadim, O.Mahgoub, B.Faye and M.M Farouk. Chapter Two. CABI International, Wallingford, England, ISBN: 978 1 780641 010, pp: 7-16.
3. Workneh, N., 2002. Socio-economic importance of camel in Ethiopia: An overview. A paper presented on the international workshop on Camel Research and Development. Formulating a Research Agenda for the Next Decade, Wad Medani, Sudan, 200: 9-12.
4. Yesihak, Y. and T. Bekele, 2003. Growth pattern of one humped camel (*Camelus dromedarius*). Proceeding of the 11th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 28-30, 2003, pp: 157-165.
5. Evans, G. and J. Powys, 1979. Camel husbandry to increase the productivity of ranchland. IFS Prov. Rep. No. 6: Camels. Int. Found. Sci., Stockholm, Sweden.
6. Mukasa-Mugerwa, E., 1981. The camel (*Camelusdromedarius*): A biographical review. International Livestock Center for Africa, Addis Ababa, Ethiopia. No. 6: Camels. Int. Found. Sci., Stockholm, Sweden. occurrence in Liben district, Borana zone of Oromia region, Ethiopia. MSc Thesis. Free.

7. Nardone, A., B. Ronchi, N. Lacetera, M. Ranieri and U. Bernabuci, 2010. Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science*, 130: 57-69.
8. Wernery, U. and O. Gaden, 2002. *Infectious Diseases in Camelids* (2nd revised and enlarged edition), Berlin-Vienna (Germany-Austria), Blackwell Wissenschafts- Verlag, pp: 404.
9. Abbas, B. and O. Omer, 2005. Review of infectious diseases of the camel. *Veterinary Bulletin*, 75, 1N16N.
10. Koenig, R., 2007. Camel scientists ask: what's sinking the ships of the desert. *Science*, 318: 1372-1373. www.sciencemag.org(accessed on March 14, 2011).
11. Roger, F., M. Guebre Yesus, G. Libeau, A. Diallo, L. Yigezu and T.Yilma, 2001. Detection of antibodies of rinderpest and peste des petits ruminants viruses (Paramyxoviridae, Morbillivirus) during a new epizootic disease in Ethiopian camels (*Camelus dromedarius*), *Revue de Médecine Vétérinaire*, 152: 265-268.
12. Bekele, T., 1999. Studies on the respiratory disease "Sonbobe" in camels in the eastern lowlands of Ethiopia. *Tropical Animal Health and Production*, 31: 333-345.
13. Bekele, T., 2006. Briefing on the status of emerging camel disease in pastoral areas of Oromia. Oromia Pastoral Development Commission, Addis Ababa, Ethiopia.
14. Gluecks, I. and M. Younan, 2010. Camel sudden death syndrome: outbreak of unknown Camel disease in the horn of Africa. ELMT (Enhanced Livelihood in the mandera triangle) Technical Brief. www.elmt-relpa.org/Accessed on 4th of July, 2010.
15. Dawo, F., 2010. Mysterious mortality in camels (*Camelus dromedarius*) in Borana, Ethiopia: evidence of its association with reproductive age groups. *Revue Scientifique et Technique Office International des Epizooties*, 29: 621-628.
16. Ndikumana, J., J. Stuth, R. Kamidi, S. Ossiya, R. Marambii and P. Hamlett, 2000. Coping mechanisms and their efficacy in disaster-prone pastoral systems of the Greater Horn of Africa. Effects of the 1995-1997 drought and the 1997-1998 El Niño rains and the responses of pastoralists and livestock. International Livestock Research Institute (ILRI) Project Report. ILRI, Nairobi, Kenya.
17. Megersa, B., A. Regassa, B. Kumsa and F. Abuna, 2008. Performance of camels (*Camelus dromedarius*) kept by pastoralists with different degrees of experience in camel keeping in Borana, southern Ethiopia. *Journal Animal Science*, 79: 534-541.
18. Care-Ethiopia, 2009. Value chain analysis of milk and milk products in Borana pastoralist area. Regional resilience enhancement against drought project, Yonas business promotion and consultancy p l c, addis baba, Ethiopia, pp: 12-25.
19. Borana Zone Pastoral Area Development Office, 2009/10. Annual Livestock Population and Diseases Report of Borana Zones Pastoral Districts. Borana Zone Livestock Population Report, Cattle Population and Diseases.
20. Coppock, D.L., 1994. The Borana Plateau of Southern Ethiopia: Synthesis of Pastoral Research, Development and Change 1980- 91. ILRI, Addis Ababa, Ethiopia.
21. Demeke, G., 1998. Prevalence of camel trypanosomes and factors associated with the disease occurrence in Liben district, Borana zone of Oromia region, Ethiopia. MSc Thesis. Free University of Berlin, Addis Ababa University, FVM, DebreZeit.
22. United Nations Office for the Coordination of Humanitarian affairs (UN-OCHA) Report, June, 2003. (accessed 16 January 2009): "Heavy rains in Borana and Guji Zones of Oromiya Region cause critical and potential water problems" Although this source states the administrative change occurred September 2003; this is an understandable mistake due to the Ethiopian year starting in September 2.
23. Megersa, B., 2010. An epidemiological study of major camel diseases in the Borana lowland, Southern Ethiopia. The Dryland Coordination Groups (DCG), Grensen 9B Oslo. DCG Report No.58.