

HUSBANDRY PRACTICES OF EL- KABABISH CAMEL HERDERS: CASE STUDY NORTH KORDOFAN STATE, SUDAN

O. M.A. Abdelhadi¹, S.A. Babiker², M.B. El-Emam³ and B. Faye⁴

¹Department of Animal Production, Faculty of Natural Resources & Environmental Studies, University of Kordofan, Sudan

²Department of Meat Production, Faculty of Animal Production, University of Khartoum, Sudan,

³Department of Animal Production, Faculty of Agriculture and Natural Resources,
University of Kassala, P.O. Box 12, New-Halfa, Sudan

⁴CIRAD, UR 18, Campus International de Baillarguet, 34398 Montpellier Cedex 5, France

ABSTRACT

The present work aimed to study husbandry practices of camel herders in north Kordofan state, Sudan. A total of 122 farmers were randomly selected using questionnaire technique. The questionnaire was conducted between March and April (2007) in 4 different areas (Sodary, Jabra, Umgrfa and Almuwelih), dominated by Kababish camel herders. The results indicated that 59% of camel farmers were owners, while 41% were shepherds. Illiteracy among camel owners was 48.6% and among shepherd was 56%. Average herd size was 85.1 ± 37.2 heads. Camel herders keep high percentages of breeding females (74.2%) while breeding males amounted to 25.2% in different herds. Sheep and goats were also raised besides camels. Castration of males was practiced for fattening purposes by 40% of the farmers. Seasonal migration was practiced by the majority of the herders to the northern and southern parts of the state. The study reported the presence of twelve camel diseases, whereas local knowledge was extensively practiced in combating diseases. Most of the farmers (75.4%) use the money returns from selling of camels in other activities rather than adding new animals to their herds.

Key words: Camel herders, husbandry practices, marketing, migration

The Arabian camel is a primary inhabitant of the northern half of Africa and the Middle East. Dromedaries are extremely adapted to hot weather and harsh environments (Ismail, 1987). They serve as a source of cheap power for drawing water from wells, oil extraction from oil seeds and as beast of burden. However, besides power and transport they provide milk and meat in extremely harsh environments. (Khan *et al*, 2003).

Sudan camel population is about 4.4 million heads which ranks world second after Somalia (FAO, 2008). Local consumption of camel meat escalated from 1,900 tons in the year 2002 to 55,000 tons (Ministry of Animal Resources and Fisheries, 2008). There are three main types of management systems, the traditional nomadic; semi- nomadic and sedentary systems which permit wide utilisation of the range lands (Abbas *et al*, 1992). The potential of camel husbandry for food production in arid areas is well appreciated among scientists and some ecologists (Faye and Esenov, 2005). Camel herders developed their own strategies and practices to deal

with different environmental changes and crises to achieve their goals (Yaqoob and Nawaz, 2007).

The objective of this work is to study husbandry practices of El- Kababish camel herders in north Kordofan state, Sudan to generate the specific objectives: general information about camel herders, use of local knowledge adopted in management, reproduction and nutrition, diseases and treatments, marketing and uses of money returns from camel sales.

Study Area and Methods

The study was conducted from March to April, 2007 in north Kordofan state, western Sudan in three locations dominated by El-kababish herders (Sodary, Jabra and Umgrfa) in north Kordofan state. It also included one of the important camel markets (Almewlih) visited by El-Kababish herders in Khartoum state (adjacent Kordofan state in NE direction).

A total of 122 camel herders owing 10,386 heads were interviewed using semi structured

SEND REPRINT REQUEST TO O.M.A. ABDELHADI [email: abusin911@yahoo.com](mailto:abusin911@yahoo.com)

questionnaire. General information was collected concerning camel herders, herd size and composition, husbandry practices (management, reproduction and nutrition), diseases and marketing of camel.

Statistical analysis

The data was subjected to statistical analysis using (SPSS) and Principal Component Analysis (PCA). Microsoft excel program was used to produce figures shown in the results.

Results and Discussion

General information

Camel herders interviewed were aged between 24-70 years old (46 years old on average). The herders were classified into owners and shepherds who represented 59% and 41%, respectively. The study revealed that 50.8% of the camel herders were illiterate, 24.6 Primary, 2.5 Secondary and 16.4 pre-school education (Khalwa). However, illiteracy among camel herders was 27.9% and 22.9% for owners and shepherds, respectively. These findings were lower than those reported by Musa *et al*, 2006 who indicated 79% of the nomads were illiterate in north Darfur state (adjacent to N. Kordofan state from the west). High percentage of illiteracy was found in Umgrfa and Sodary 60% and 50.8%, respectively.

Other animals reared beside camels

Generally north Kordofan state is highly populated with camels and ranks the first (127 million heads) among other states in the country (Ministry of Animal Resources and Fisheries, 2008). The northern parts of the state are dominated by El-Kababish camel herders. These herders (49.2%) were found rearing camels only. Camels and small ruminants were

raised separately. The main purpose behind rearing small ruminants was local sales to satisfy family needs, religious and social ceremonies and to pay for penalties when camels intrude into other people's farms. These findings are in accordance of the Gihad (1995), Steinfeld (1998) and Musa *et al* (2006).

Camel herd size and composition

Camel herd size ranged between 11–219 heads with an average of 85.1±37.2 heads. The breeding males and females comprises on average 71% of total herd structure (18.3% breeding males, 52.7% breeding females) and young calves from both sexes represented 29% (newly born 13.3, suckling 5.1 and weaned 10.6%). These findings agreed with El Zubier *et al* (2006) who reported camel herders tended to keep more females in their herds compared to males. Percentages of breeding female of El-Kababish camel herd was slightly lower than the value of 60% reported by Köhler *et al* (1991) for Rashida camel herds in Eastern Sudan and Sakr and Majid (1998) who gave 62% breeding females in the Eastern Sudan too. Table 1 shows herd size and composition in different locations. No significant differences were observed in herd size, breeding males and females between Jubra, Sodary and Almewlih location. Only in Umgrfa location had significantly lower values ($P<0.001$) compared with the other locations. The analysis of variance showed significant differences ($P<0.05$) in newly born males, weaned and suckling males and females. Numbers of newly born, suckling and weaned camel calves of both sexes were low. This could be attributed to low herd fertility, low feeding conditions and calf mortality among herds.

This is in accordance with Elamin (1990) who indicated 51% fertility rate of camels in Sudan which

Table 1. Herd size and composition of camels in the study area.

Measurement	Location				Overall means
	Jabra	Almewlih	Sodary	Umgrfa	
Number of herds	50	15	42	15	122
Herd size	95.8 ^a	90.7 ^a	84 ^a	47.1 ^b	85.1
Breeding males	17.3 ^a	16.2 ^a	15.6 ^a	9.1 ^b	15.6
Breeding females	50.1 ^a	43.4 ^a	46.5 ^a	24.2 ^b	44.9
Newly born males	5.9 ^a	7.9 ^b	4.7 ^a	3.4 ^a	5.4
Suckling males	2.1 ^a	1.13 ^{a, b}	1.9 ^a	0.5 ^b	1.7
Weaned males	4.5 ^a	4.9 ^a	4.5 ^a	2.8 ^b	4.4
Newly born females	6.6 ^b	9.5 ^a	4.6 ^{b, c}	3.4 ^c	5.9
Suckling females	2.3 ^a	1.4 ^{a, b}	1.5 ^a	0.5 ^b	1.7
Weaned females	4.8 ^a	6.2 ^b	4.6 ^a	4.9 ^a	4.7

- Means in the same row carrying the same superscript are not significantly different.

is linked to the findings of Wardeh (1989) that calving rate ranged between (40-70%) in Sudan depending on the production system adopted. Total mortality rate among young calves in the present results was 11.8% which goes in line with Elamin (1990) who indicated 11.7% calf mortality in Sudan and contrasted the findings of Kaufmann (1998) who reported high camel calf mortality between 22-27%. According to Abbas *et al* (1993) 43.4% of the questionnaires pastoralists in eastern Sudan complained from calf mortality while 7.4% considered it as disease priority. Ali *et al* (2005) reported 40% camel calf mortality in eastern Sudan. Hussain and Hjort (1998) reported 30% mortality rate from birth to one year of age in Somalia. In conclusion, calf mortality is considered as a one of the major constraints to higher productivity of camels, however, calf diarrhoea is considered the major cause. No significant difference were found between different locations in calf mortality except for Almwelih ($P < 0.05$).

Age nomenclature

It was found that the nomads classified their camels according to age by local names: less than one year of age Huwar, one year mfred, two years wadlaboon, three years higg, four years gadaa, five years rabaa and seven years sdees. This finding agreed with Musa *et al* (2006). Highly significant difference ($P < 0.001$) was found in herd size at each age group except for sdees (three pairs of permanent incisors).

Multivariate analysis allowed identifying 5 types of camel herds (table 2) with different age groups which reflected different strategies for herd management. Indeed, according to Kaufmann (2005) herd demography was influenced by the reproductive parameters: age at first calving, calving interval, mortality and culling rate. Herd type 4 and 5 could

be considered as milk producers due to significant higher percentage of breeding females compared to the other herds. The calving interval in camel being approximately 2 years, the fecundity rate is around 50% (Bakheit *et al*, 2008). Wardeh (1989) stated that calving rate ranged between 40-70% in Sudan. Usually, the weaning occurred between 6 months and one year in most of the case in traditional system. So, theoretically, the number of new born + suckling calves is close to the number of weaned calves if there is no selling or purchasing and if the fecundity rate is the same from one year to another. Low percentage of newly born calves compared to breeding females was observed among herds indicating low fertility and fecundity rate. The ratio newborn and suckling calves/ total females was around 30% in types 4 and 5 vs. around 40% in types 1 and 3 and 52% in type 2. Elamin (1990) indicated 51% fertility rate of camels in Sudan. We can suggest that the dairy producers (types 4 and 5) either have a low fecundity rate in general for the current year or have a higher male offspring in order to keep milk. However, the differences between weaned males and females appear almost similar in all the types and we can suspect a low fertility rate. Moreover, the ratio weaned animals/ total females varied from 15% (type 2) to 31% (type 1). This could be due either to a very low fertility in the former year, or a high mortality rate especially in type 2. In herd type 1 suckling calves from both sexes appeared very low.

This could be attributed to calf mortalities in the current year compared to other herd types. This also goes in line with Ali *et al* (2005) who reported 40% camel calf mortality in eastern Sudan. The ratio breeding males/ breeding females was around 31% (type 4), 36% (types 5 and 2) and 41% (types 3 and 5). These findings indicated that breeding females comprises the highest proportion of the herds

Table 2. Relationship between herd compositions in% with herd types.

Herd composition%	Type 1	Type 2	Type 3	Type 4	Type 5	Level of significance
Breeding females	47.6 ^c	49.0 ^b	48.8 ^b	55.4 ^a	53.3 ^{ab}	0.05
Breeding males	19.4	17.8	19.3	17.1	18.4	NS
Newly born females	8.7	8.9	7.5	6.8	6.6	NS
Newly born males	7.8	9.3	6.0	6.2	6.9	NS
Weaned females	7.6 ^a	3.8 ^c	6.3 ^{ab}	5.6 ^b	5.6 ^b	0.05
Weaned males	7.1	4.0	5.5	5.1	5.1	NS
Suckling females	1.0	2.5	2.8	1.9	1.9	NS
Suckling males	0.9 ^c	4.9 ^a	2.9 ^b	2.0 ^{bc}	2.0 ^{bc}	0.05
Total%	100	100	100	100	100	

- Means in the same row carrying the same superscript are not significantly different.

between 60–80% to breeding males 30–41%. This goes in line with (El Zubier *et al*, 2006) but higher than those reported by Köhler *et al* (1991) and Sakr and Majid (1998) in eastern Sudan for breeding females 60 and 62%. This could probably be considered as strategy adopted by camel herders in north Kordofan state (mostly desert) compared to the eastern Sudan, so the herders keep more breeding females to maintain high production and compensate losses from high mortalities among calves or low fecundity rate as a result of drought and/or diseases as well as maintaining certain level of revenue from selling mature male camels due to high prices compared to females.

Husbandry practices

Castration of males

It was found that 40.2% of the camel herders practiced male castration for the purpose of fattening and behavior control. Different tools were used like knives (27%) and other materials such as sharp blades (13.2%) with a high significant differences ($P < 0.001$) among locations. Castration was applied from Higg (three years old) comprises 4% to Tani (five years) 6% of camel herds.

Reproduction and Breeding practices

Breeding females within the herds were grouped into first and multiparity females represented 17.1 and 82.9%, respectively from total breeding females. Significant differences were found between Umgrfa and other locations for the first parity and multiparity ($P < 0.05$). Two breeding seasons were indicated by the majority of the herders (69.7%) during autumn (July - October) and winter season (November - February) due to the availability

of water and green fodder. However, 27% of the herders indicated that the breeding season took place only during autumn, while in winter only 3.3%. These findings agreed with Lahou *et al* (1989) who stated that reproduction performance was a seasonable phenomenon that took place during the rainy season and Dioli *et al* (1992) who concluded that males of camels started the breeding season during autumn and stopped during the dry season in summer.

Most of the camel herders were found to practice inbreeding (79.5%) to conserve important production characteristics in their herds, while 20.5% followed out-breeding to improve the potentials of their herds. The ratio between breeding males and females was one male to 25 females as however, in some herds extended one male to 50 females. This was in accord with the findings reported by Musa *et al* (2006) who indicated one breeding male was used for 25 females. Males were kept with females in the same herd except during fattening; they were separated in one herd.

Nutrition and management

The herders were able to give a list of desirable trees and grasses (table 3). Multi plant species from grazing and browsing trees and shrubs were followed by the herders in the range land as a feeding strategy to their camel herds for better utilisation of the pasture. Dereje and Udèn (2005) indicated that browsing/ grazing was the dominant daytime activity of camels in both dry and wet seasons, followed by walking, resting and ruminating. According to this study camel herders indicated that camels preferred browsing (56%) than grazing (44%). Grazing was increasingly practiced due to the continuous cutting of trees from camel habitat which agreed with Bakheit

Table 3. Desirable trees and grasses reported by Kababish camel herders.

No.	Trees		Grasses	
	Local name	Scientific name	Local name	Scientific name
1.	Hashab	<i>Acacia senegal</i>	Bgel	<i>Blepharis linarifolia</i>
2.	Kitr	<i>Acacia mellifera</i>	A-shoup	<i>Cyprus rotundus</i>
3.	Sial	<i>Acacia tortilis</i>	Shara	<i>Indigofera hochstetter</i>
4.	Hijlej	<i>Balanites aegyptica</i>	Hasknet	<i>Cenchrus biflorus</i>
5.	Marikh	<i>Leptadenia pyrotechnica</i>	Gaw	<i>Aristida pallida</i>
6.	Sareh	<i>Maerua crassifolia</i>	Rabaa	<i>Trianthema pentandra</i>
7.	Sidir	<i>Ziziphus spina-christi</i>	Sesame jemal	<i>Sesamum alatum</i>
8.	Laot	<i>Acacia oerfota or nubica</i>	Dahayan	<i>Farsetia longisiliqua</i>
9.	Andrab	<i>Cordia sinensis</i>	Difra	<i>Echinochloa colonum</i>
10.	Godiem	<i>Grewia tenax</i>	Hantont	<i>Ipomoea kotschyana</i>

and Majid (2006) who indicated that dromedary camel was predominantly a browser except in the northern part of north Kordofan and Darfur and in the Gizo grazing areas where grass was the food of choice. No supplementary diets were used by the herders except the addition of salt and "Atroon" (raw Ca (HCO₃) to the drinking water as a mineral supplement which confirmed the results reported by Musa *et al* (2006).

The nutritional management practices of Kababish camel herders are linked to the mobility (table 4). Nomadism is extensively practiced by camel herders. Large number of camel owners (98.4%) indicated that they practice seasonal migration (south-north) in autumn and (north-south) during summer seeking water and pasture to their animals. This migration took on average 5.8 ± 1.2 months depending on the availability of water and pasture. Elamin, (1979) also reported that camel- owning tribes were continually on the move, looking for grazing and water for their animals.

Wardeh (1989) reported that in western Sudan the herds move in the rainy season from south to the north for long distances that could reach 1000 km in search of water and feed. Similarly, in eastern Sudan (Rashida) were reported to practice seasonal migration in a north-south direction. The amplitude of their annual migration varies from year to year depending on the amount of rainfall, but in a normal year the range is between 200 and 300 km (http://en.wikipedia.org/wiki/Camel_farming_in_Sudan seen in April, 2010). Time spent on both browsing and grazing was significantly higher ($P < 0.001$) in winter compared to summer season [12.3 versus 10.5 hours] and the rest of the day was spent in resting and rumination. These findings were lower than those reported by Khorchani (1992) who indicated that camels spent 77.3% of the day time feeding. He also concluded that in summer, the grazing was reduced at the end of afternoon and no further increase in grazing time would, therefore, be expected if the herds were allowed to stay longer on the range.

Wardeh (1999) reported that camels spent 6-8 hours per day in good range condition and 12 hours in poor ones, while Kassily (2002) reported camel grazing day length was fixed to about 10 hours per day. It could be concluded that forage quality influences feeding patterns of camels, however, under adverse pasture conditions; the time available for grazing would be a limiting factor to their dry matter (DM) and nutrient intake.

Watering interval of camel herds was found (5-8) days with an average of 7 days during summer; however, in winter it increases to (18-24) days with an average of 20 days. This indicated that watering interval depended on many conditions like: season of the year, ambient temperature, and quality of the pasture (availability of succulent plants) and water. This agreed with Ramet (2001) who concluded that when green forage was available in mild climates; the camel may go several months without drinking. Dioli *et al* (1992) stated that in dry season when temperature was high watering of camels was required every 5 to 8 days. However, Wilson (1984) indicated that camels might drink every 8 to 10 days in hot conditions, while Köhler *et al* (1991) found that Rashida camels required watering once every 6 days. This could be explained by the ability of camels to loss body weight and water during dehydration compared to other species. Farid (1989) reviewed the effect of water deprivation in camels, Merino sheep and shorthorn cattle. Author indicated that 20% body weight loss occurred in 7 to 10 days in camels, 4 to 5 days in sheep and 2 to 3 days in cattle when the mean maximum temperature was above 40° C. Death from the loss of 28-32% of body weight occurred in about 15 days in camels, 7 days in sheep and 4 days in cattle. Camels are able to decrease metabolic rate during extreme cases (Dahlborn *et al*, 1992).

Identification of animals

Animals were identified by the herders using hot branding or marking to draw certain tribal and

Table 4. Nutritional management practices by EL-Kababish camel herders.

Measurement	Place of interview				Overall means
	Jabra	Almewlih	Sodary	Umgrfa	
Number of herds	50	15	42	15	122
Seasonal migration (<i>month</i>)	6.0 ^b	5.0 ^c	5.4 ^{b, c}	7.6 ^a	5.8 ± 1.2
Browsing & grazing in winter (<i>hrs</i>)	12.6 ^a	12.0 ^a	12.2 ^{a, b}	12.1 ^{a, b}	12.3 ± 0.09
Browsing & grazing in summer (<i>hrs</i>)	10.9 ^a	10.3 ^a	10.1 ^a	10.0 ^a	10.5 ± 0.15
Water interval in winter (<i>days</i>)	18.1 ^b	24.5 ^a	21.2 ^{a, b}	22.8 ^{a, b}	20.6 ± 0.76
Water interval in summer (<i>days</i>)	7.6 ^a	7.1 ^a	7.4 ^a	5.7 ^b	7.3 ± 0.12

- Means in the same row carrying the same subscript are not significantly different.

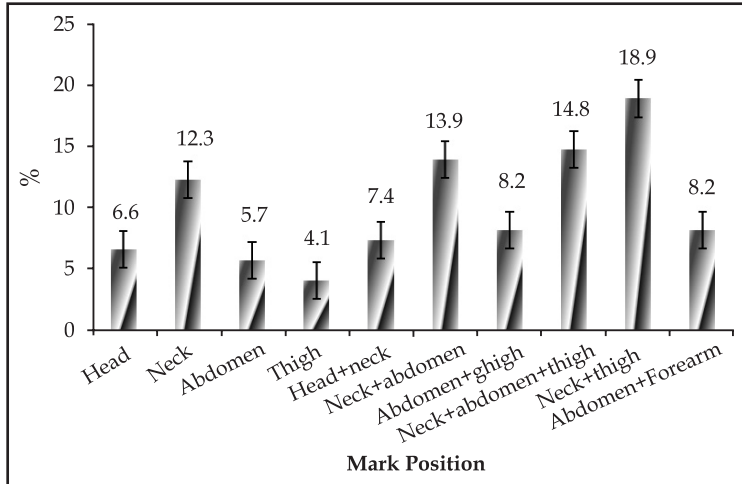


Fig 1. Practice of hot branding by camel herders in north Kordofan state, Sudan.

owner symbols in different parts of the camel's body. These marks or symbols are known by the herders from different tribes. Kohler (2004) reported that camel herders practiced branding with specific symbols of tribe, village or clan to identify and control their herds. Hot branding of camels on neck+thigh represented about 19%, followed by neck + abdomen + thigh about 15%, while thigh branding alone represented 4% of camel herds.

Diseases

Table (5) illustrates local and English names of diseases in percentage ranking as their importance to the herders and type of medication used. A total of twelve camel diseases were reported by El-Kababish herders which were locally known as: Kassara, Hulaa, Juffar, Jarab, Reah, Ghoob, Godad, Nehas, Na'aita,

Julakh, Jadari and Reet. It was observed that: Juffar, Jarab, Hulla, Godad and Reah diseases had the highest percentage as important camel diseases in the area. These findings agrees with Hakimdar (1987) who reported that Trypanosomosis (Jufar) affected all ages of camels in Sudan specially more than 4 years old. However, Fadl- Elmula *et al* (1994) reported that Mange disease (Jarab) severely spread among camel calves less than 2 years old during autumn and winter. It also goes in line with Dioli *et al* (1992) and Chandra *et al* (1998) that camel pox (Jadari) was one of the most important viral diseases in camels which exist in eastern Africa. Agab *et al* (1998) concluded that (calf diarrhoea) caused mortalities that occur during summer season amounting to 39.1% and 80% in winter. Also Ali *et al* (2005) reported an incidence of 83% calf diarrhoea in camel herds from eastern Sudan while Abbas *et al* (1992) indicated that camel calf diarrhoea affected about 33% of the neonates causing 23% mortality in northeast Sudan. The herders in the present work indicated the use of veterinary treatment in addition to local knowledge for the treatment of some diseases.

Marketing

Camels were marketed in local markets: Almzroob, Almwelih, Umgrfa, Hmrat- Elsheikh, Umbadir, Sodary and Elobeid or either exported to the neighboring countries as Egypt, Libya, Saudi Arabia and Gulf States. These findings agreed with Ahmed, (2000) and Kohler *et al* (1998). The percentage of marketed males and females were found 90.2%

Table 5. Local and English name of camel diseases, infection rate and type of treatment reported by camel herders.

Disease		(%)	Type of treatment
Local name	English name		
Juffar	Trypanosomosis	73.8	Veterinary medicines
Jarab	Mange	68.9	Veterinary medicines + local knowledge
Hulaa	Haemonchosis	55.7	Veterinary medicines + local knowledge
Godad	Abscessation	54.1	Veterinary medicines + local knowledge
Reah	Abscises	44.3	Veterinary medicines + local knowledge
Nuhas	Pneumonia	37.7	Veterinary medicines + local knowledge
Jadari	Camel-Pox	36.1	Veterinary medicines
Reat	Calve diarrhoea	28	Veterinary medicines
Ghoop	Ringworm	12.3	Veterinary medicines + local knowledge
Na'aita	Contagious skin necrosis	9.8	Veterinary medicines + local knowledge
Julakh	Contagious ecthyma	4.9	Veterinary medicines + local knowledge
Kassara	Tick born disease	4.1	Veterinary medicines + local knowledge

and 63.1%, respectively (Table 6). This might be attributed to high prices of males which are exported to neighboring countries compared to females which are slaughtered at old ages for local consumption. In addition to that local regulations restrict export of female camels. Babiker and Tibin (1989) reported that camel's males were marketed in the age of 5-6 years, however, females were mainly slaughtered for local consumption while the majority of males kept were exported. Most of the camel herders (75.4%) indicated that they expended the revenue of camel sales in other activities rather than adding new animals to their herds. These activities included: purchase of food for their families, education of children, purchase of veterinary medicines, watering the animals, paying Zakka and penalties of intruding into other people's farms.

Conclusion

It could be concluded that extension services and education of camel herders are crucial to improve their way of living and production. Natural feed supply is dwindling which will lead to under nutrition. Castration of males was observed to be practiced in old age, however, better results could be achieved in young age. Drought is the main constrain in such areas beside the disappearance of desirable plants which forced the herds to move south words far from their living habitat. This causes infection with diseases (Trypanosomosis) and conflicts with farmers as well. More efforts should be done to reduce camel diseases in the production areas to eliminate the incidence of infection especially among young calves. Feed supplementation is needed to prevent under nutrition stress of animals on the range. Range rehabilitation is crucial to provide feed, reduce erratic movement and seasonal migration of animals and also to reduce animal susceptibility to diseases and parasitic infection. Hot branding is extensively practiced among camel herds which will eliminate the use of camel skins in the future.

Table 6. Numbers and percentages of camels marketed by camel herders locally in the year 2006.

Sex	No. of camels marketed	Percentage of marketed	Percentage of un marketed
Males	1 - 5	83.6%	9.8%
	More than 5	6.6%	
	Total	90.2%	
Females	1 -5	59.9%	36.9%
	More than 5	3.2%	
	Total	63.1%	

Acknowledgements

Thanks to the staff of Community Development Fund (CDF) at Sodary and Jabra localities and the staff of International Fund for Agricultural Development (IFAD) at Umgarfa village, north Kordofan state, Sudan. Thanks are extended to DAAD, Germany for their in country support and also to Mr. Salam Bakheit and Moneer Elyas from University of Kordofan for their assistance.

References

Abass B, Mohamed GE, Agab H, Yagoob SD and Mustafa K (1992). Clinical observation on field cases of some camel diseases with emphasis on diarrhoea in camel calves. Presented at the 5th conference of General Federation of Arab Veterinarians, Khartoum-Sudan, Jan. 12-16. Conference Abstract Book. pp 53.

Abass B, Saint Martin G and Planchenaut D (1993). Constrains to camel production in eastern Sudan: A survey of pastoralist conceptions. *Sud. Journal of Veterinary Science and Animal Husbandry* 32:31-42.

Abbas B, Chabeuf N, Saint- Martin G, Bonnet P, Millairid A, Bashir H and Musa ME (1992). Camel pastoralism in Butana and Northern Sudan. *Nomadic Peoples* 31:64-84.

Agab H and Abbas B (1998). Epidemiological studies on camel diseases in Eastern Sudan. *Camel Newsletter*, 14:53-57. The Arab Centre for the Studies of Arid Zone and Dry Lands (ACSAD), Damascus, Syria.

Ahmed AJ (2000). Problems and obstacles facing camel marketing in Sudan. Conference of Treasury ministers of marginal sates. Aldamar, Sudan.

Bakheit SA, Faye B, Kijora C and Abu-Nikkeila AM (2008). Effect of management system on Sudanese camels calving interval. Proceedings of WBC/ICAR 2008 Satellite meeting on camelids reproduction., Budapest (Hungary), 12-13 July 2008, P. Nagy and G. Huscencza (Eds), 74-76.

Bakheit SA and Majid AM (2006). Seasonality and Parity effect on Milk yield of camels Raised under pastoral system in north Kordofan of Sudan, proceeding of the international Scientific conference on Camels, 10 -12 May, 2006, College of Agriculture and Veterinary Medicine, Qassim University, Kingdom of Saudi Arabia pp 2331-2338.

Bakheit SA (2008). A comparative study of productive and reproductive performance of camels (*Camelus dromedarius*) under semi-intensive and traditional systems in western sudan. PhD thesis, University of Khartoum, Sudan.

Chandra R, Chauhan RS and Garg SK (1998). Camel pox. *Camel Newsletter*. The Arab Centre for the Studies of Arid Zone and Dry Lands (ACSAD), Damascus, Syria.

Dahlborn K, Benlamlah S, Zine FR, Guerouali A, Hossaini HJ and Oukessou M (1992). Food deprivation and re-feeding in the camel. *The American Physiological Society*, Vol. 31:1000-1005.

- Dereje M and Udèn P (2005). The browsing dromedary camel 1. Behaviour. Plant preferences and quality of forage selected. *Journal of Animal and Feed Sciences* 121:297-308.
- Dioli M and Stimmelmayer R (1992). Import of camel diseases. The one humped camel, A Practical Guide to Diseases, Health Care and Management. Berlin, Germany.
- El Zubier EM and Nour EM (2006). Studies on some camel management practices and constraints in pre-urban areas of Khartoum state, Sudan. *Inter. Journal of Dairy Science* 1(2):104-112.
- Elamin EA (1990). The camel economic state in Sudan. Camel newsletter: Vol. 7. Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), Damascus, Syria.
- FAO (2008). Food and Agriculture Organisation, statistics division. <http://faostat.fao.org>.
- Fadl- Elmula A, Agab H, Horne JM, Abass B and Abdalla AB (1994). First isolation of *Trychophyton verrucosum* as the etiology of ring worm in Sudanese camels. *Revue d'élevage et de Médecine Vétérinaire des Pays Tropicaux* 47(2):184-187.
- Farid MFA (1989). Water and minerals problems of the dromedary Camel (an overview). *Options Méditerranéennes - Série Séminaires*, No (2):111-124.
- Faye B and Esenov P (2005). Desertification Combat and Food Safety. The added value of camel Producers. ISO Press and NATO Public Diplomacy Division, Netherland.
- Gihad EA (1995). Arabian Camels, Production and Culture. Animal Production Department Faculty of Agriculture, Cairo University. Arab Publishing and Distribution Company Arabic).
- Hakimdar ES (1987). Some epidemiological studies on camel Trypanosomiasis in western Sudan. M.V.Sc Thesis, University of Khartoum, Sudan. http://en.wikipedia.org/wiki/Camel_farming_in_Sudan- seen in 2010.
- Hussain MA and Hjort A (1988). Camel herd dynamic in Somalia. In: camels in development: Sustainable production in African dry lands. Scandinavian Institute of African Studies, Uppsala. pp 105-117.
- Ismail ST (1987). A review of reproduction in female camel (*Camelus dromedaries*). *Theriogenology* (28)3:363-371.
- Kassilly FN (1993). Forage behavior and diet characteristics of the one humped camel (*Camelus dromedarius*) in central Baringo, Kenya. Msc. Thesis, University of Nairobi.
- Kassilly NF (2002). Forage quality and camel feeding pattern in Central Baringo, Kenya. *Livestock Production Science*, 78:175-182.
- Kaufmann BA (2005). Reproductive performance of camels (*Camelus dromedarius*) under pastoral management and its influence on herd development. *Livestock Production Science* 92:17-29.
- Kaufmann BA (1998). Analysis of Camel Husbandry in Northern Kenya. Verlag Josef Margraf, Weikersheim, Germany. pp 194.
- Khan BB, Iqbal A and Raiz M (2003). Production and Management of Camels, Pakistan. T. M. Printers, Aminpur Baxar, Faisalabad.
- Kohler RI (1991). *Camelus dromedarius*. In: mammelia Species. No. 375.
- Kohler RI (2004). Why do Rajasthan camels need to be saved? Working paper presented at the International Conference: "saving the camel and people's livelihood" Building a multi-Stakkeholder platform for the conservation of the camel in Rajsthan 23rd-25th November, 2004 at Sadri, Rajasthan.
- Kohler RI, Musa BG and Ahmed F (1998). Proceedings of the 3rd Annual Meeting for Animal Production Under Arid Conditions. Vol. 2. United Arab Emirates University.
- Lahlou KA, Anouassi A and Sghiri A (1989). Nutrition et Reproduction chez le dromadaire. *Options Méditerranéennes. Série Séminaire* No 2:141-149.
- Ministry of Animal Resources and Fisheries (2008). Statistical Bulletin for Animal Resources. Issue No. 18.
- Musa HH, Shuiep ES and El Zubier EM (2006). Research note: Camel husbandry among pastoralists in Darfur, western Sudan. *Nomadic People* (10)1:101-105.
- Ramet JP (2001). The technology of making cheese from camel milk (*Camelus dromedarius*). FAO Animal production and Health Paper; 113, Rome.
- SPSS (2005). Statistical Package for Social Sciences, windows evaluation program version 15. <http://www.spss.com>.
- Sakr I and Majid AM (1998). The social economic of camel herders in Eastern Sudan. The camel Applied Research and development Network/ CARDN/ ACSAD/ Camel/ 1-27.
- Wardeh MF (1989). Arabian Camels: Origin, Breeds and Husbandry. Al-Mallah Publ., Damascus, Syria. pp 500 (Arabic).
- Wardeh MF (1999). The origin of camels and their economic importance in the Arab countries. The 3rd Arab Vet. Conference, Amman, Jordan.
- Wilson RT (1984). The Camel. London, Group Ltd.
- Yaqoob M and Nawaz H (2007). Potential of Pakistani camel for diary and other uses. *Animal of Science Journal* 78:467-475.