



Full Length Article

A Survey of Camel Production in Three Different Ecological Zones of Pakistan

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Abstract

This field survey was conducted in three districts of Punjab, Pakistan, to study the dromedary camel production and traditional management practices. A total of 75 households were interviewed on the management, significance and constraints associated to the camel production in the area using a single-visit-multiple-subject diagnostic survey. According to the camel breeders' responses, the family living status of the camel herders has improved in all three ecological zones. Most of the camel herders were keeping Marecha, Campbelpuri and Brela camel breeds at Faisalabad, Attock and Bhakkar zones. Major source of income of the camel herders at all zones were sale of milk and meat, sale of animals and crop cultivation. Majority of the herders kept their camels in open air system and take their camels for grazing from morning till evening at all the zones; however comparatively the trend of supplementation was more at Faisalabad zone. Camels play an important role in the socio-economics of the nomadic people in this area. In order to improve the camel production in the study area, Livestock and dairy development department and local NGO'S should take into consideration the importance of camel and the prevalent problems in the area. © 2013 Friends Science Publishers

Keywords: Survey; Production; Traditional management; Dromedary camel; Pakistan

Introduction

The livestock sector is an essential part of agriculture in Pakistan. It plays an important role in the agriculture sector and in the national economy of Pakistan. Livestock accounts for 37% of the agriculture Gross Domestic Product (GDP) and 8% of the national GDP. Among livestock, camel farming contributes a major part of total livestock production in certain geographic locations of the country. Pakistan possesses about 23% camel population of Asian countries and rates fourth in the world following Somalia, Sudan and Mauritania (FAOSTAT, 2005). There are about 0.328 million households linked one way or another with camel production in Pakistan (Anonymous, 2008-2009). The camel is capable of surviving under harsh and arid environmental conditions (Schwartz, 1992). It can survive and reproduce under a management system with low inputs, harsh environmental conditions and difficult landscapes in arid and semi-arid regions where survival of other animals is usually at risk. Camel is an important multi-purpose animal for socio-economic needs of the inhabitants of deserts, mountainous regions and even the irrigated plains of Pakistan (Jasra and Isani, 2000; Khan *et al.*, 2003; Ahmad *et*

al., 2010; Samara *et al.*, 2012; Pasha *et al.*, 2012).

In Pakistan, camels are mainly kept by the migratory pastoralists in subsistence production systems in the arid and semi-arid regions (Iqbal *et al.*, 2012). However, camel contribution to the agriculture economy of Pakistan is not well assessed. In addition to being a pack and draft animal, the camel is a good source of milk, meat and hides for the residents of the extreme desert areas. Camel milk is sold in small quantities and is also given away or shared with neighbours. The major importance of camel milk is its availability in dry seasons and during times of drought when milk from other livestock is inadequate. The dairy potential of camels appears to be higher than that of cows reared under the same climatic and management conditions (Faye, 2005). The milk yield ranges between 900 and 4000 L in one lactation period (250-500 days). The camel meat is largely consumed by the people of rural and remote areas of Pakistan, as most of the people of cities have not developed the taste for it. However, this trend is going to be changed with time due to awareness of the people living in the cities about the medicinal importance of camel milk (Khan *et al.*, 2003; Khan, 2012; Sazmand *et al.*, 2012). According to an estimate over 798,000 tons of milk is being annually produced in Pakistan (Anonymous, 2008-2009). The trend

of slaughtering camels on Eid-ul-Azha (the great feast when people slaughter animals in large numbers) is increasing steadily. Camels are also used as draft power for ploughing land, drawing water from wells, oil extraction, grinding of wheat, corn, grains and for sugarcane crushing (Khodaie, 2002; Khan *et al.*, 2003). Some researchers like Jasra and Isani (2003); Khan *et al.* (2003); Jasra and Isani (2000) and Jasra *et al.* (1999), discussed and documented the production, management and socio-economic importance of camels in Pakistan, however a deep insight into the camel production and management in these areas of Punjab was lacking. So this study was designed to conduct a survey in three ecological zones; Faisalabad (FSD), Attock (ATK) and Bhakkar (BKR), to collect data and understand the status of the production and traditional management system of the camels in these regions of Punjab, Pakistan.

Materials and Methods

Description of the Study Area

This study was conducted in three different ecological zones of Punjab, Pakistan including Faisalabad (FSD), Attock (ATK) and Bhakkar (BKR). Faisalabad stands in the flat plains of northeast Punjab, between longitude 73°74 East, latitude 30°31.5 North, with an elevation of 184 m above sea level (Anonymous, 2011a). This area is included in the agro ecological zone-IV A (Northern irrigated plains). The mean annual rainfall ranges from 300 to 500 mm. (Rahim *et al.*, 2011).

Attock district city is located on the northern border of the Punjab at 33° 46'20 North Latitude and 72° 22' 6 East Longitude. It has an altitude of 384 meters above sea level (Falling rain Genomics-Attock city). This area falls in agro ecological zone-V (Barani), climatically, area lying along the mountains is nearly humid (experimental area; Attock), while in southern part, it is semi-arid and hot. The mean monthly rainfall is approximately 200 mm in summer and 36 to 50 mm in winter (Rahim *et al.*, 2011).

Bhakkar district is located between 31° 10' and 32° 22' North Latitude and 70° 47' and 72° East Longitude, most of it lies in the deserted plain of the Thal (Anonymous, 2011b). This area is included in the agro ecological zone-III. A and B (Sandy deserts) having narrow strips of sand ridges and dunes, the climate is arid to semi-arid subtropical continental and mean monthly highest maximum temperature goes up to 45.6°C, while in winter it goes from 5.5 to 1.3°C. In the region mean annual rainfall ranges from 150-350 mm, increasing from south to north (Rahim *et al.*, 2011).

Sampling Method and Data Collection

A questionnaire survey was conducted in all three zones to collect data on the comprehensive production system, traditional husbandry practices, contributions of dromedary

camel and breeding management variables using a single-visit-multiple-subject diagnostic survey (ILCA, 1990). A total of 75 households (25 in each of the three districts including, FSD, ATK and BKR), who owned camels and acquainted with the camel husbandry were selected using purposive sampling technique. The production system variables included general management, housing, feeding, breeding, disease control and production constraints as perceived by the owner and solutions sought. Special emphasis was given to reproductive parameters such as age at puberty, selection of bull camel, breeding season and others. All the information was obtained from camel owners by means of a semi-structured questionnaire.

Statistical Analysis

Microsoft Excel (Microsoft Office 2003) was used for data compilation. Ranking of the major contributions of dromedary camel was performed by using method described by International Livestock Center for Africa (ILCA, 1990). Means were compared by one-way analysis of variance (ANOVA). Descriptive statistics (frequencies, percentages) and correlation among different parameters of traditional husbandry practices and reproductive performance were derived using windows, STATISICA 6.0.

Results

The Socio-economic Importance of Camels

Camels played an important role in the economy of the zones under study. Most of the camel herders at all three zones (FSD 93.3%, ATK 53.3% and BKR 73.3%) responded that their living status had improved as compared to 20 years back. According to camel herders, mainly male camels are used for draft purpose (60%), (65%) and (70%) at FSD, ATK and BKR zones (Fig. 1). Studies revealed that female animals constitute more than 70% of a camel herd (Table 1). Most of the respondents were having Marecha (Mahra), Cambelpuri and Brela camel breeds at FSD, ATK and BKR zones, respectively (Table 2). The high number of female camels is required to fulfil the milk requirements of the herders. The number of male camels remained low, because the majority of male camel calves slaughtered in their early age, others allowed to grow up to 4-5 years of age. At this age most of them were castrated, sold and slaughtered. The main seasons of camel sales are monsoon and then Eid ul Azha festival at all three zones. Most of the respondents used to sell camels to the beopari with a price depending upon the animal condition and demand (Table 3). Major sources of income of the camel herders were sale of milk, meat and animals and to some extent crop cultivation (Fig. 2).

Traditional Management System of Camels

Camel housing: Most of the camel herders (100% at FSD,

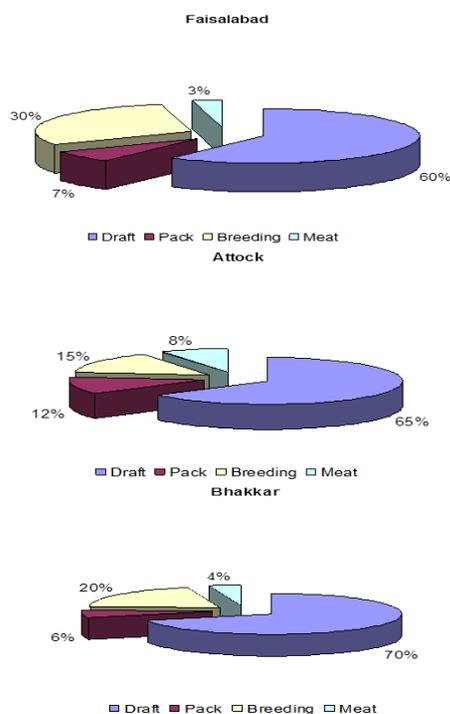


Fig. 1: Work performed by male camels at three zones under study

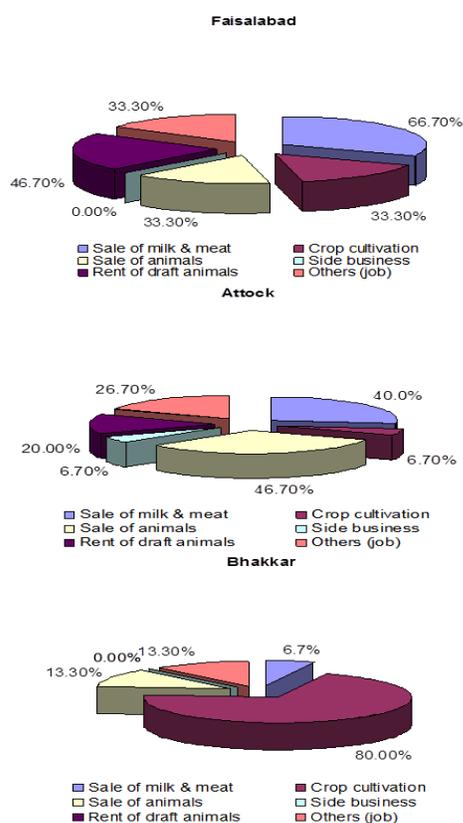


Fig. 2: Major income source of camel herders at three zones under study (73.3% at ATK and 93.3% at BKR), kept their camels in

Table 1: Number and age of respondents interviewed and number of livestock per family in three ecological zones

	Zones		
	FSD	ATK	BKR
No of respondents	25	25	25
Age of respondents (Years)	28-50	30-61	30-60
No of domestic animals per family			
Buffalo	1.13±0.24 ^a	0.73±0.18 ^{ab}	0.27±0.18 ^b
Cattle	0.87±0.19	0.73±0.25	1.53±0.31 ^{NS}
Sheep (male)	0.13±0.13 ^b	0.60±0.21 ^a	0.07±0.07 ^b
Sheep (female)	0.40±0.19 ^b	1.33±0.33 ^a	0.20±0.14 ^b
Goat (male)	0.73±0.21	0.73±0.21	1.33±0.33 ^{NS}
Goat (female)	1.60±0.45	1.47±0.27	4.00±0.57 ^{NS}
Camel (male)	1.13±0.13 ^b	1.67±0.19 ^a	1.00±0.10 ^b
Camel (female)	3.87±0.42	4.67±0.45	4.93±0.65 ^{NS}
Donkey	0.53±0.13 ^a	0.20±0.11 ^b	0.13±0.09 ^b
Horse	0.00±0.00	0.13±0.09	0.00±0.00 ^{NS}

Means sharing similar letters in a cell are statistically non-significant (P>0.05). Means were compared by ANOVA and significance by DMR test

Table 2: Proportion (%) of the camel breeds in three ecological zones of Punjab Pakistan

Camel Breeds	Zones under study		
	FSD	ATK	BKR
Brela (Thalocha)	0.0	0.0	53.3
Marecha (Mahra)	86.7	0.0	6.7
Desi	13.3	0.0	40.0
Cambelpuri	0.0	100.0	0.0

Table 3: Types of camel sales (%) in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Main season of camel sale			
Winter	0.0	0.0	0.0
Dry	0.0	0.0	0.0
Monsoon	33.3	60.0	86.7
Eid	66.7	40.0	13.3
Purpose of sale			
Cash	73.0	26.7	53.3
Animal purchase	14.0	20.0	46.7
Home occasions	0.0	26.7	0.0
Animal purchase & cash	13.0	6.6	0.0
Others	0.0	20.0	0.0
Sale to?			
Beopari	60.0	40.0	80.0
Market	40.0	40.0	20.0
Others	0.0	20.0	0.0
Price depending on?			
Animal condition	80.0	73.0	85.0
Demand	20.0	14.0	5.0
Trade competition	0.0	13.0	10.0
Do you purchase camels and why?			
Yes for draft	40.0	46.7	53.7
Yes for business	60.0	53.3	33.3
No	0.0	0.0	13.0

open air at all three ecological zones under study (Table 4).

Drinking water sources: According to respondents, the major sources of water for camel herders were rivers and

pumps at FSD, wells and pumps at ATK and wells at BKR

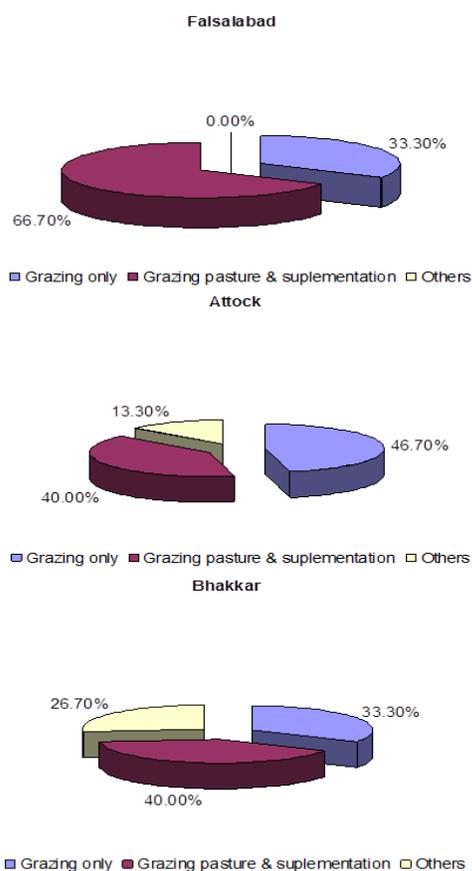


Fig. 3: Feeding system of camels at three zones under study

zone (Table 5). During winter season, watering interval for camels was one week at FSD, 3-7 days at ATK and BKR zones, however this interval was 12 h during summer season at all the localities.

Feeding of camels: Most of the camel herders adopted the grazing system at all zones; however, grazing and supplementation system (wheat straw, guwara husk and linseed cake) was more at FSD as compared to ATK and BKR regions (Fig. 3).

Camel Productivity and Reproductive Performance

Milk, meat and hair production: Most of the husbandry and management practices of the camel herders are geared towards improvement of milk production and continuous supply of milk for the family's needs throughout the year. The average daily milk yield varied from 3–8 L. Production depends on the breed of camel, age, lactation period, season of the year and availability of browse and water. According to camel herders, meat production was 175.3, 232 and 210 kg) and hair production was 2.67, 2.13 and 1.47 kg, at FSD, ATK and BKR zones respectively (Table 6).

Work performance: The load carrying capacity was higher in the camels of ATK zone (439.7 kg), than BKR (383 kg) and FSD (341 kg) zones. Riding speed was

Table 4: Proportion (%) of camel housing and feeding systems in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Camel housing			
In stable yard	0.0	26.7	6.7
In open air	100.0	73.3	93.3
*Supplements or special feed			
Wheat straw	66.7	73.3	73.3
Guwara husk	26.7	46.7	46.7
Linseed cake	26.7	6.7	53.3
Gram bhoosa	0.0	0.0	33.3
Butter	0.0	0.0	20.0
Taramera oil	0.0	26.7	0.0

*The time of delivery of the supplements or special feed was afternoon and evening at all three studied zones

Table 5: Types of watering (%) of camels in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Major Source of water			
Wells	0.0	60.0	93.3
Rivers	33.3	0.0	0.0
Seasonal water spots	0.0	6.7	6.7
Others (Pumps)	66.7	33.3	0.0
Watering timing of camels (winter)			
Everyday	0.0	13.3	0.0
Third day	0.0	53.3	20.0
Weekly	100.0	33.3	80.0
Summer			
Everyday	100.0	100.0	100
Second day	0.0	0.0	0.0
Third day	0.0	0.0	0.0
Weekly	0.0	0.0	0.0

Table 6: Work performance and production traits of male camels (Mean \pm SEM) (data collected from families in three ecological zones of Punjab Pakistan)

Parameters	Zones under study		
	FSD	ATK	BKR
Hair production (kg)	2.67 \pm 0.16 ^a	2.13 \pm 0.13 ^b	1.47 \pm 0.13 ^c
Meat production (kg)	175.3 \pm 11.0 ^b	232.0 \pm 3.93 ^a	210.6 \pm 7.34 ^a
Riding speed (km/hr)	6.80 \pm 0.28 ^a	5.20 \pm 0.17 ^b	4.67 \pm 0.21 ^b
Load carrying capacity (kg)	341.5 \pm 22.45 ^b	439.7 \pm 7.47 ^a	383.1 \pm 12.20 ^b
How often use camels (hrs/day)	6.27 \pm 0.51	6.93 \pm 0.56	7.73 \pm 0.25 ^{NS}
Average distance traveled by camels (km)	24.93 \pm 1.25 ^c	29.53 \pm 1.34 ^b	35.53 \pm 1.41 ^a

Means sharing similar letters in a cell are statistically non-significant ($P > 0.05$). Means were compared by ANOVA and significance by DMR test

higher at FSD zones (6.8 km/h), then ATK (5.2 km/h) and BKR (4.67 km/h). Herders used their camels for 6.27 h/day, 6.93 h/day and 7.73 h/day at FSD, ATK and BKR zones, respectively. Camels travelled about 24.93 km at FSD, 29.53 km at ATK and 35.53 km at BKR zone (Table 6).

Reproductive performance: The age of puberty of male camels was 4.5-5 years at FSD zone, 4-5 years at ATK and 4 years at BKR zone. According to camel herder, the season of sexual activity of male camels ranged from December to March at FSD, November to April at ATK and November to March at BKR zone. Herders assessed the male fertility

Table 7: Reproductive management (%) and reproductive performance traits (Mean \pm SEM) of male camels (%) in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Age of puberty of male camel			
4 years	0.0	40.0	80.0
4.5 years	26.7	20.0	20.0
5 years	73.3	40.0	0.0
Should we reduce age of puberty			
Yes	100.0	100.0	100.0
No	0.0	0.0	0.0
Season of sexual activity			
Nov-March	46.7	46.7	73.3
Dec-March	53.3	0.0	20.0
Nov- April	0.0	53.3	6.7
Signs of rut			
Smell of poll glands secretions	40.0	86.7	100.0
Soft palate extrusion (duula)	26.7	20.0	86.7
Gurgling sounds	46.7	33.3	20.0
Others	0.0	13.3	0.0
Fertility assessment of male camel			
Body condition	80	55	65
Genitalia conformation	8	35	20
Fertility history	12	10	15
How long breeding bull was used for breeding			
10 years	0.0	0.0	53.3
15 years	40.0	46.7	40.0
20 years	33.3	53.3	6.7
30 years	26.7	0.0	0.0
Do you assist bull during mating?			
Yes	66.7	46.7	60.0
Occasionally	33.3	53.3	40.0
No	0.0	0.0	0.0
*Reproductive traits	124.5 \pm 2.22 ^b	135.6 \pm 2.85 ^a	123.2 \pm 1.24 ^b
Peak rutting vigor (days)			
Mount per day (number)	3.60 \pm 0.29 ^b	5.07 \pm 0.21 ^a	4.53 \pm 0.19 ^a
Duration of copulation (min)	27.67 \pm 1.75 ^b	35.00 \pm 1.20 ^a	18.53 \pm 0.84 ^c

*Means sharing similar letters in a cell are statistically non-significant (P>0.05). Means were compared by ANOVA and significance by DMR test

from body condition and genitalia conformation of the camels. Camel herders used their male up to 15 years at FSD, 20 years at ATK and 10 years at BKR zone. Most of the respondents assisted their male camels during the act of copulation. Peak rutting vigour was 124 days, 135 days, and 132 days in the male camels of FSD, ATK and BKR zone. Mount per day was recorded as 3, 5 and 4 times at FSD, ATK and BKR. The duration of copulation was more at ATK (35 min), then FSD (27 min) and BKR (18 min) (Table 7).

Breeding management: Respondents practiced culling at FSD was 46%, 73.3% at ATK and 86.7% at BKR zone due to low productivity (33.3%) and old age (33.3%) at FSD, low productivity (33.3%) and reproductive problems (46.7%) at ATK while low productivity (53.3%) and old age (46.7%) at BKR zone. All camel herders were interested to breed more camel. Productivity of camels mainly influenced by calving period at FSD zone, however; mortality was the major cause of low productivity at ATK and BKR (Table 8).

Health management: The camel is more prone to

Table 8: Breeding management of camels (%) in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Practice culling			
Yes	46.7	73.3	86.7
No	53.3	26.7	13.3
Why do you practice culling?			
Low productivity	33.3	33.3	53.3
Reproductive problems	6.7	46.7	13.3
Old age	33.3	13.3	46.7
Do you want to breed more camels?			
Yes	100.0	100.0	100.0
No	0.0	0.0	0.0
Advantages of rearing camels over other livestock			
Input minimum	13.3	53.3	46.3
Useful	86.7	46.7	53.3
How to increase production?			
Better feed	0.0	26.7	26.7
Breeds	20.0	53.3	20.0
Both	80.0	20.0	53.3
Productivity of camels influenced by which of the following?			
Mortality	20.0	66.7	40.0
Calving period	80.0	33.3	26.7
Both	0.0	0.0	33.3

Table 9: Health management of camels (%) in three ecological zones of Punjab Pakistan

Parameters	Zones under study		
	FSD	ATK	BKR
Vaccination			
Yes	0.0	26.7	0.0
Sometimes	33.3	33.3	40.0
No	66.7	40.0	60.0
Common diseases			
Surra	18	20	55
Mange	14	45	25
Digestive problems	10	11	10
Pox	58	24	10
Seek Veterinary assistance			
Yes	53.3	60.0	13.3
No	20.0	6.7	6.7
Occasionally	26.7	33.3	80.0
How handle reproductive problems			
Sell them	66.7	40.0	60.0
Treat them	33.3	60.0	39.8

diseases as compared to other animals. Most of the respondent 66.7%, 40% and 60.0% at FSD, ATK and BKR zones did not vaccinate their animals. 46% at FSD, 40% at ATK and more than 80% at BKR did not or occasionally seek veterinary assistance for the treatment of health problems for their camels. According to camel herders, common diseases of camel were Pox followed by Surra at FSD, Mange followed by Pox at ATK zone and Surra followed by Mange at BKR zone (Table 9).

Discussion

The study revealed that the family living status of the camel herders has improved as compared to 20 years back at all the

locations with the improvement was greater at FSD zone. These differences could be attributed to the socio-economical factors and development in one zone from the other in respect to roads and transportations among other factors. It also could be due to increase in the number of animals each family have before and after 20 years. Most of the camel herders were keeping Marecha, Cambelpuri and Brela camel breeds at FSD, ATK and BKR zones respectively. These findings are comparable with Isani and Baloch (2000) and Khan *et al.* (2003) who reported Campbelpuri, Brela and Marecha as main breeds of ATK, BKR and FSD respectively. At all three locations, male camels were mainly used for draft purpose and females primarily for milk and secondarily for draft purpose along with other utilities like pack, game, meat, hair, hide production and agricultural use. Main occasions of camel sale were the monsoon and then Eid-ul-Azha at all three zones. Major source of income for most of the camel herders at all zones were sale of milk and meat, sale of animals and crop cultivation. Camels played and continue to play an important role in the local economy of the zones under study as they are in entire Pakistan (Iqbal, 1999; Khan *et al.*, 2003; Ali *et al.*, 2009; Hussain, 2010; Ahmad *et al.*, 2010).

High percentage of camel herders surveyed kept their camel in open air. The major sources of water for camels were river and electric pumps (water motors) in FSD, wells and pumps at ATK and mainly well at BKR zone. The watering interval was about one week during winter season at all the locations. Herders offered water to the camels every day during summer season. Most of the camel herders used to take their camels for grazing from morning till evening in all three zones. Grazing system is more at ATK region, while trends for supplementation was more at FSD as compared to ATK and BKR zones, which may be attributed to the vegetation and climate of the ATK region (Rahim *et al.*, 2011). Meat production was highest at ATK followed by BKR and FSD zones; while hair production was highest at FSD zone. The load carrying capacity was more in ATK zone, riding speed was higher with the camels of FSD, and herders used camels for more time per day at BKR zone. Puberty started earlier in camels of BKR zone, may be accredited to the daily temperature (mean daily temperature in summer goes up to 45.6°C and falls down up to 1.3°C in winter) (Rahim *et al.*, 2011). The period of sexual activity started earlier in November and extended more even up to April at ATK as compared to other zones. This variation may be attributed to the climatic conditions, as it is cooler at ATK zone compared to the others. The results confirmed the findings of Jasra and Isani (2000), who reported that the breeding season of camel in irrigated plains of Sindh and Punjab starts in December and extend up to March, while in cooler areas it may continue even up to April. Male camels are used for breeding even up to 20 years of age at ATK zone. Duration of copulation was up to 35 min at ATK zone, so it can be derived that the males of ATK zone are more efficient in reproduction as compared to FSD and BKR. This

kind of deduction was taken into consideration as the female camel is induced ovulator and therefore certain time is really needed to allow the release of enough luteinizing hormone which, in turn, results in release of the ovum (Skidmore and Adams, 2000). It is obvious from the present investigation that Pox, Mange and Surra are the more common diseases of camels at these localities of Punjab. These findings are in line with other workers (Aujla *et al.*, 1998; Jasra and Isani, 2003; Hasan *et al.*, 2006; Ali *et al.*, 2009; Bhutto *et al.*, 2010; Raziq *et al.*, 2010), who have reported these diseases as major problem of the camels in the Pakistan.

In conclusion, the living status of the camel herders of the zones under study has improved. This change can be interpreted as coincidental findings due to so many factors which may affect living standard and improvement. Among other issues addressed within this study we believe one should pay attention to camels' nutrition and recommend using supplements in diet in all three regions. Camels in this area feed entirely on unimproved natural vegetation of low nutritive value and trend of supplementation is not up to the mark. If the practice of supplementation will be adopted through herders' education, it will improve camels' performance, productivity, reproduction as well as resistance to diseases.

Acknowledgements

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References

- Ahmad, S., M. Yaqoob, N. Hashmi, S. Ahmad, M.A. Zaman and M. Tariq, 2010. Economic importance of camel: A unique alternative under crises. *Pak. Vet. J.*, 30: 191–197
- Anonymous, 2008-2009. *Pakistan Economic Survey*. Ministry of Finance, Government of Pakistan, Islamabad, Pakistan
- Anonymous, 2011a. Faisalabad District Government, <http://www.faisalabad.gov.pk/>. Accessed: 16 May 2011
- Anonymous, 2011b. Bhakkar District Government; <http://www.bhakkar.com.pk/>. Accessed: 15 May 2011
- Aujla, K.M., A.W. Jasra and M. Munir, 1998. Socio-economic profile of camel herders in South-western Mountainous areas of Pakistan. *Proceedings of the Third Annual Meeting for Animal Production under Arid Conditions*, Vol. 2, pp: 154–174
- Ali, I., S. Chaudhry and U. Farooq, 2009. Camel rearing in Cholistan desert of Pakistan. *Pak. Vet. J.*, 29: 85–92
- Bhutto, B., J.A. Gadahi, G. Shah, P. Dewani, A.G. Arijjo, 2010. Field investigation on the prevalence of trypanosomiasis in camels in relation to sex, age and herd size. *Pak. Vet. J.*, 30: 175–177
- Falling rain Genomics-Attock city, 2011. http://www.fallingrain.com/world/PK/04/Attock_City.html. Accessed: 14 May 2011
- FAOSTAT., 2005. <http://faostat.fao.org/faostat/collections?subset=agriculture>. Accessed: 9 March 2011
- Faye, B., 2005. Productivity Potential of Camels. Proc. of Int. Workshop. Desertification Combat and Food Safety – The Added Value of Camel Producers. Ashkabad (Turkmenistan), 19-22 April 2004. NATO science Series, *In: Life and Behavioral Sciences*, Vol. 362, pp: 127–134. Faye, B. and P. Esenov (eds.). IOS Press Publ., Amsterdam (The Netherlands)

- Hasan, M.U., G. Muhammad, C. Gutierrez, Z. Iqbal, A. Shakoor, A. Jabbar, 2006. Prevalence of *Trypanosoma evansi* infection in equines and camels in the Punjab, Pakistan. *Ann. New York Acad. Sci.*, 1080: 322–324
- Hussain, R., 2010. Morphological and functional characteristics of the testis of one-humped camel (*Camelus dromedarius*) in the natural ecology of Punjab, Pakistan. *Ph. D. Thesis*. University of Agriculture, Faisalabad, Pakistan (<http://eprints.hec.gov.pk/7254/1/842S.htm>)
- Isani, G.B. and M.N. Baloch, 2000. *Camel breeds of Pakistan*, p: 150. The Camel Applied Research and Development Network. CARDN-Pakistan/ACSAD/P93/200
- Iqbal, A., 1999. Studies on some of the productive, reproductive and behavioral aspects of camel in Pakistan. *Ph. D. Dissertation*, Department of Livestock Management. University of Agriculture Faisalabad, Pakistan
- Iqbal, Z., W. Babar, Z.U.D. Sindhu, R.Z. Abbas and M.S. Sajid, 2012. Evaluation of anthelmintic activity of different fractions of *Azadirachta indica* A. Juss seed extract. *Pak. Vet. J.*, 32: 579–583
- ILCA, 1990. *Livestock Systems Research Manual*. ILCA Working paper 1. International Livestock Center for Africa, Addis Ababa, Nigeria
- Jasra, A.W. and G.B. Isani, 2000. *Socio-economics of Camel Herders in Pakistan*. The Camel Applied Research and Development Network. CARDN-Pakistan/ ACSAD/P 94/2000
- Jasra, A.W. and G.B. Isani, 2003. Development constraints and drifting of camel production systems in Pakistan. *Int. J. Agric. Biol.*, 5: 14–16
- Jasra, A.W., K.M. Aujla, S.A. Khan and M. Munir, 1999. Socio-economic profile of camel herders in Balochistan, Pakistan. *Int. J. Agric. Biol.*, 1: 159–162
- Khan, B.B., A. Iqbal and M. Riaz, 2003. *Production and Management of Camels*. Department of Livestock Management, University of Agriculture, Pak. T. M. Printers, Faisalabad, Pakistan
- Khan, F.M., 2012. Field epidemiology of an outbreak of hemorrhagic septicemia in dromedary population of greater Cholistan desert (Pakistan). *Pak. Vet. J.*, 32: 31–34
- Khodaie, S.A., 2002. *Camel production system and the socio-economics of camel herders in the Islamic Republic of Iran*, p: 107. The Camel Applied Research and Development Network (CARDN)/ACSAD/Camel, 2002
- Pasha, R.H., A.S. Qureshi, L.A. Lodhi and H. Jamil, 2011. Biometric and ultrasonographic evaluation of the testis of one-humped camel (*Camelus dromedarius*). *Pak. Vet. J.*, 31: 129–133
- Rahim, S.M.A., S. Hasnain, J. Farkhanda, 2011. Effect of calcium, magnesium, sodium and potassium on farm plantations of various agroecological zones of Punjab, Pakistan. *Afr. J. Plant Sci.*, 5: 450–459
- Raziq, A., K.D. Verdier, M. Younas, 2010. Ethnoveterinary treatments by dromedary camel herders in the Suleiman Mountainous Region in Pakistan: an observation and questionnaire study. *J. Ethnobiol. Ethnomed.*, 6: 16
- Samara, E.M., K.A. Abdoun, A.B. Okab and A.A. Al-Haidary, 2012. Exercise and dehydration minimized bleeding time in camels (*Camelus dromedarius*): A clinical standpoint. *Pak. Vet. J.*, 32: 432–434
- Sazmand, A., A. Rasooli, M. Nouri, H. Hamidinejat and S. Hekmatimoghaddam, 2011. Serobiochemical alterations in subclinically affected dromedary camels with *Trypanosoma evansi* in Iran. *Pak. Vet. J.*, 31: 223–226
- Schwartz, H.J., 1992. Productive performance and productivity of dromedaries (*Camelus dromedarius*). *Anim. Res. Dev.*, 35: 86–98
- Skidmore, J.A., G.P. Adams (Eds.) 2000. *Recent Advances in Camelids Reproduction. Ovulation failure due to inadequate LH release in response to copulation*. Int. Vet. Information Services. Ithaca, New York. USA. <http://www.ivis.org/> accessed 3/30/2012

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