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Characterization and financial viability of camel production system based on community pastures and forest lands in Rajasthan

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Abstract
Camel herding and breeding, an age old traditional occupation, is not only a significant source of livelihoods and household employment for animal pastoralist and farming communities in western and southern Rajasthan, but also an important desert draft animal for army, transportation and agriculture. In this study on characterization and financial viability of camel breeding enterprise, primary data of randomly selected 157 camel breeders' households from western and southern Rajasthan were collected and used. Camel breeding under extensive system was the main occupation for more than 90 percent of sample households with average herd size of 37 and 21 camels in western and southern Rajasthan, respectively. Net returns per camel herd per year were estimated at Rs. 7147 and Rs. 101451 with B: C ratio of 1.05 and 1.99 in western and southern Rajasthan, respectively. The camel herding was found financially viable enterprise in both the regions of Rajasthan with a payback period of 04 to 08 years, positive net present value (NPV), and internal rate of return (IRR) of 27.55 and 55.73 percent. The study indicated that the enterprise remains financially attractive in southern Rajasthan but losing its advantage in traditional western region mainly due to market factors and feed scarcity and needs appropriate strategies for sustainable camel production.

Keywords: Camel production, Investment, Management, Marketing, Returns

Introduction

Camel is a very important animal in the dry regions because of its ability to provide milk, meat and transport for people under the adverse climatic conditions. It is traditionally reared in extensive area with low feed quality and availability (Abdalatif *et al*., 2013). Camel (*Camelus dromedarius*) herding and breeding an age old traditional occupation has been the major source of livelihood and household employment for animal pastoralist and farming communities including *Raika, Sindhi muslims, Jats and Bisnoi* in Rajasthan state of India. Camel can survive and reproduce under a low inputs management system, harsh environmental conditions and difficult landscapes in arid and semi-arid regions where survival of other animals is usually at risk (Schwartz, 1992; Kohler-Rollefson, 1997). It has a unique ability to convert the poor plant resources of the desert into milk, meat and fibre (Rathore, 2001). Hence, Camel herding and breeding enterprise even today is one and only source of livelihood for many families of camel pastoralist and farming communities in Rajasthan. The use of camel for transportation of goods/building materials/farm produce in different regions of Rajasthan is a common practice and thousands of families earn their livelihood from this enterprise (Kaushik *et al*., 1991; Kohler-Rollefson, 1992; Gahlot and Chada, 2000; Abrhaley and Leta, 2018). However, the continuously decreasing population of camel in the state of Rajasthan and country (Govt of India, 2014) has been a worrisome issue for all the stakeholders. It would be important to understand the camel production system, resource use and its socio-economics in order to devise strategies for its sustainability. However, there is limited information on characteristics of camel production systems and socio-economics of camel breeding enterprise in India. Hence, a study was conducted among camel breeders in western and southern Rajasthan and aimed to analyse the production system and financial viability of camel breeding enterprise and policy interventions needed to improve livelihoods of camel breeders.

Materials and Methods

***Study site and design*:** In Rajasthan, camel herders and

breeders mainly reside in western (Pali and Jaisalmer districts) and southern regions (Udaipur, Dungerpur and Banswara districts). Hence, these districts were selected for present study. A multistage stratified random sampling technique was used to draw the sample (n=157) for this investigation with at least 10 camel per family. The secondary data were collected from various reports and state animal husbandry department of Rajasthan. Primary data related to investment on camel and other permanent items, feeding practices followed round the year, supplemental feed, health management of animals, age at sale of camel calves, place of sale, value of animals sold, and losses if any etc. was collected during the period 2007-12 from selected respondents. Both personal interview technique and group discussion method was followed for collection of data. Key informants interviews were also conducted to know in detail the overall camel breeding practices.

***Data analysis*:** Standard enterprise budgeting methods were used for calculating variable and fixed cost of camel production (Johl and Kapoor, 2005). The financial viability of camel production was assessed using project worth measures such as net present value (NPV), pay-back period, internal rate of return (IRR) and benefit-cost ratio (BCR); computed using the standard methods (Gittinger, 1982).

Results and Discussion

***Composition of sample camel herds*:**

Camel herders mainly herded female animals for breeding purpose and young male calves produced in the herd were marketed as livestock (an economic produce) for earning the income by the entrepreneurs within age range of 1 to 2 years. The average camel herd size was found to be of 37 units and 21 units of camel in western and southern Rajasthan, respectively. Shuiep *et al*. (2014) reported average herd size of 23 animals in Sudan in nomadic system of camel rearing which almost similar to herd size maintained in southern Rajasthan. Female animals constituted more than 80 percent of herds (Table 1). Overall value of camel herds (animals) was found to be Rs. 7.25 lakh and Rs. 4.11 lakh in western and southern Rajasthan, respectively, in which the share of female animals was more than 80 percent of total investment.

Investment pattern

Fixed investment on a camel herd mainly comprised of animals, as its share in total investment was more than 97 percent (Table 2). The camel herders keep bare minimum items with them as they frequently move from one place to another. The proportionate investment on equipment and bedding etc was found to be a meagre 0.4 to 2.6 percent. It was evident that cost of female animals was the most important component of total fixed capital investment. Breeders of southern Rajasthan did not have any investment on enclosure as animals stay in forest/common area and farmers' field for grazing. In case of equipments only few utensils were kept for collecting milk and making tea while *bhakal* (a rough carpet made of camel wool) was also kept for using as bedding by the herders during night.

Table 1. Composition and value of camel on sample herds (Rs./herd)

Particulars	Southern Rajasthan (n= 75)		Western Rajasthan (n= 82)	
	No.	Value (Rs.)	No.	Value (Rs.)
Male				
< 1 yr	3.26	28635	2.18	23,591
1-2 yr	1.65	20861	1.69	1,562
2-4 yr	0.16	3463	0.08	4,213
> 4 yr	0.32	9745	0.17	52,238
Sub total	5.38	62705	4.11	22,872
	(14.60)	(8.65)	(19.52)	(12.70)
Female				
< 1 yr	4.05	32810	2.20	20,933
1-2 yr	3.07	40407	1.86	25,171
2-4 yr	3.18	62660	2.12	39,197
> 4 yr	21.12	526647	10.76	2,73,925
	(57.39)	(72.61)	(51.11)	(66.57)
Sub total	31.42	662525	16.95	359226
	(85.40)	(91.35)	(80.48)	(87.30)
Grand total	36.80	725230	21.06	411464
	(100.00)	(100.00)	(100.00)	(100.00)

Figures in parenthesis indicate percentage to grand total

Resource use pattern and management

***Land utilization pattern*:** The operational holding size of camel breeders in western and southern Rajasthan was found to be 3.18 ha and 1.23 ha, respectively. Rajput and Tripati (2009) reported 13 percent camel owners were in landless category and traditional camel breeders in Kutch district of Gujarat had very low land holding (Patel *et al.,* 2008). Kohler-Rollefson (1992) pointed out that Raika gradually being forced out of their traditional occupation because of their landlessness. Camel breeders were more dependent on income from sale of camel calves and camel milk. As camel was not reared on stall feeding, breeders did not cultivate crops keeping in view the camel production. Breeders who are not able to meet their own fodder requirement, they procure it either from fellow farmers or from surrounding regions. However, camels

Table 2. Investment pattern on camel herds (Rs./herd)

Items	Western Rajasthan		Southern Rajasthan	
	Amount (Rs.)	Percent	Amount (Rs.)	Percent
A. Animals	725230	99.5	411464	97.4
Male	62705	8.6	52238	12.4
Female	662525	90.9	359226	85.1
B. Manger and enclosure	750	0.1	0	0.0
C. Equipment, beddings and others	3,114	0.4	10,820	2.6
Total	729093	100.0	422284	100.0

are better adapted to survival in areas with harsh climatic conditions than 'conventional' domestic livestock species (Wilson, 2017).

***Housing management*:** Camel breeders of both regions do not create any housing structure for the animals. In Pali district about 40 percent camel breeders made enclosures for the camel using plant material/ thorny bushes etc. These breeders keep the animals in the enclosures around eight months in a year while in rainy season animals are kept in the farmers' fields near forest area. Camel breeders of Jaisalmer district keep animals in temporary enclosures made of ropes in *gochar* (lands reserved for animals grazing in villages) during rainy season so that animals do not damage the crops in the farmers fields. Saini *et al.* (2006) also reported similar practice in various camel rearing areas of Rajasthan. In all the selected areas of southern Rajasthan, camel remained in forest/ common areas or farmers' fields round the year. In rainy season animals were kept inside the forest land, hillocks or farmers' fields near forest area. One of the front leg of all animals in herd is generally tied after folding it from knee joint with a piece of rope during night time to check their movement but breeding bull is generally kept free so that it can have mating with the females in heat. Regarding personal dwellings only 5 percent families had pucca (stone/ brick) houses that too belonged to large farmer's category. Rajput and Tripati (2009) also reported that majority of Raika families (46.67%) were residing in mixed type of houses followed by those spending their live in kutcha or mud houses (27%).

***Human labour utilization*:** Family labour dominated the camel rearing with 84 percent share in total labour employed. Mainly adult male labour 1.48 units and 1.25 units per herd were employed in western and southern region, respectively as animals were kept outside village round the year. The role of women members was almost negligible as they did not move with herd during local grazing or at the time of migration like in case of small ruminants' migration. In some cases (40 percent) like in Pali district where animals are kept at home during night women labour take care of young calves for few days after birth as these did not move with herd for grazing. In Fatehgarh tehsil of Jaisalmer district also women members of the family take care of calves for initial one month. Labour is usually hired either if the herd size is big and family labour is not able to handle it or it is mainly needed in winter season when maximum calving takes place and extra manpower is required. Besides it, maximum camel trade takes place in winter due to organisation of livestock fairs in this season, help of hired labour is required either in transporting animals to fair site or take care of animals at village itself. Saini *et al.* (2006) reported similar practice in various camel rearing areas of Rajasthan. Rajput and Tripati (2009) mentioned role of male and female members of Raika families in various outdoor as well as indoor camel husbandries related activities. The male members of Raika families performed work like taking camel to grazing pastures, ploughing land, carting, training to camel, milking, treatment of sick animals through indigenous preparation, grooming, watering, cutting and transportation of fodder for camels etc. where the involvement of females in such activities was found almost negligible.

***Breeding and calf management*:** Camel breeders follow natural breeding method and for a herd of 40-50 females one camel breeding bull is maintained. As average no. of females in a herd varied from 11 to 31 animals, herd owners shared the breeding camel bull to economise on cost account. Chand *et al.* (2010) in a survey of arid region of Rajasthan found one breeding male for 50 females in a camel herd. The breeding camel bull was replaced after 4 years to check inbreeding in the herd, indicating that breeders were well aware about the disadvantage of inbreeding in the herd. The selection criteria for breeding camel included mother's milk yield, well built body, body colour, hump thickness, thin skin, long and thin leg, size of chest pad, scrotum position, length and development etc. Breeding camel bull is exchanged with other herds after 3 years for checking

inbreeding. Breeders were more interested in having camel of original breed as animals produced with this breed's characteristics fetch more prices in the market. Calves were reared with herd except in Pali and Jaisalmer districts where these are reared for few days at home itself. It was observed in the field that calves reared with their mothers and taken to browsing area were healthier as compared to calves kept at home. This was due to the fact that calves kept at home get mother's milk either in the morning or night time while calves remaining with herd while browsing have freedom to suckle mother's milk whenever feel hungry. The ectoparasites (ticks) load was also more in calves kept at home than the calves remain with herd, affecting their health adversely.

***Feeding/ browsing management*:** In both regions of state, animals were taken for browsing in forest areas in rainy season and in summer and winter season to fallow cultivated land, *gochar* (CPRs) land and *oran* (land reserved for animals grazing in the name of local deities) for grazing. Shuiep *et al*. (2014) reported that in Sudan under nomadic system, feeding camels is mainly dependent on natural grazing, which is of zero cost. The distance of grazing area could be about 20-120 km away from the breeders' village in western region while it was up to 350 km in southern Rajasthan. During rainy season Rs. 100 per camel is paid to forest department as fees and animals are taken for browsing for 4 months. During rainy season due to cultivation of crops in farmers field, breeders take utmost care that standing crop is not damaged by the animals and stay with their animals either in forest area or farmers fields near forest land.

The most nutritive and fodder plants/ trees preferred by camel in forest area of foothills of the Aravali range and Jaisalmer region are selpa/selpan (*Securingea leucopyrus*) (Willd.) Muell. arg., Arni (*Clerodanron multiflorum*) Lin., ber (*Ziziphus moritiana*), dhawra (*Anogeussus latifolia*), khair (*Acacia catechu* L.) Willd., Oliv., arjia (*Acacia leucophloea*), ker (*Capparis deciduas*) jaal (*Salvadora oleiodes*) and pharangari/Frangan (*Grewia flavescens*) Juss etc. Some other trees browsed by camel were dhak (*Buteamono sperma*), golra (*Lanneacoro mandelica*), salar (*Boswellia serrata*), gangan (*Grewia tenax*), hingota (*Balanite saegyptiaca*), kumatia (*Acacia senagal*), kankeda (*Maytenusem arginata*), and kaanti (puncture vine) (*Tribulus terrestris*) etc. These fodder trees generally consumed by camel are rich in protein and minerals (Singh and Saini, 2002; Singh *et al.,* 2015). Besides browsing in the field animal is offered sesame oil, turmeric etc after calving. Camel is also given salt at 10 days interval to fulfil its mineral requirement. Saini *et al*. (2006) also reported that majority of camel rearers give salt to camel, however, Rathore (1986) indicated that salt is not given to camel except medicinal dose because salty flora of desert meet the requirement of salt (Choudhary, 1994).The intensive discussions with camel breeders of the regions indicated rapid decline in grazing land available for camel. Camel breeders do not have access to traditional grazing lands, which are now under the jurisdiction of forest department. Village *gaucher* lands (common grazing lands), were also declining due to encroachment as well as degradation due to lack of community management (Roy, 2016). Camel has great species diversity in woodlands and bush land, moderate diversity in farmland (Salamula *et al.*, 2016).

***General upkeep of animals*:** For drinking water animals were generally dependent upon village ponds and cattle troughs (common cemented open tanks), in which water is supplied from public water supply. Camel were also taken to water structures (*avala*) made by farmers for drinking water. Frequency of watering to camel was thrice in a day during summer season while in winter season it was once or twice in day. During rainy season animals were not taken to water source as they were free to drink water collected at various places in forest area. An adult camel required 20-40 litres of water per day. Animals were generally milked in the early morning and in the day time whenever required by breeders. Generally knuckling method is used for milking of animals. Wool shearing activity was done collectively like a festivity and one person could shear wool of 4-5 camel in a day.

***Migration pattern of camel breeders*:** Camel breeders of western Rajasthan have movement within the region itself from 30 to 120 km but in southern Rajasthan breeders migrate to Gujarat and Madhya Pradesh in search of better forage resources. They stay outside for 6-8 months. Migration period starts with the onset of winter. They stay there with their animals till onset of monsoon when they move back to their native areas. The movement is along traditional fixed routes. If the native region do not have sufficient rainfall during rainy season than camel breeders delay their return journey and stay in forest area of neighbouring states until grazing condition is favourable for their animals. During migration only male members of the family move with animals while the women and older members of the family take care of children and agricultural activities on their farms.

Table 3. Fixed cost/ year in camel production (Rs./herd)

Items	Western Rajasthan		Southern Rajasthan	
	Amount (Rs.)	Percent	Amount (Rs.)	Percent
A. Interest (12%)				
Animals	63198.00	67.20	33376.50	63.84
Others	463.00	0.49	1298.40	2.48
B. Depreciation				
Animals	29615.00	31.49	15438.53	29.53
Others	773.00	0.82	2164.00	4.14
Total	94049.00	100.00	52277.00	100.00

Depreciation on animals was calculated for adult females with Junk value of Rs. 2500/- only. The normal age of female is 20 years and depreciation was taken from 5 year onward i.e. for 16 years. As young animals appreciate in value and males are generally sold, so no depreciation was taken for these animals. Depreciation on other items like utensils etc was taken @ 20 percent per annum.

Table 4. Maintenance cost per camel herd per year (Rs.)

Particulars	Western Rajasthan		Southern Rajasthan	
	Amount (Rs.)	Percent	Amount (Rs.)	Percent
1. Variable cost				
A. Grazing charges to forest department	1112.00	0.81	1093.00	1.06
B. Material cost	4707.00	3.43	11869.98	11.53
Fodder (Neem)	00.00	00.00	2732.50	2.65
Concentrate, oil, and other miscellaneous exp.	4707.00	3.43	9137.48	8.88
C. Veterinary Expenditure	5815.00	4.24	7366.82	7.16
D. Labour cost			30327.95	29.46
Labour for grazing & Gen Mgt.	30274.00	22.08	30000.00	29.14
Wool shearing	1162.00	0.85	327.95	0.32
E. Total variable cost (A+B+C+D)	43070.00	31.41	50657.75	49.21
2. Fixed cost				
A. Interest	63661.00	46.43	34674.90	33.69
B. Depreciation	30388.00	22.16	17602.53	17.10
Total fixed cost (A+B)	94049.00	68.59	52277.43	50.79
Total cost (1 + 2)	137119.00	100.00	102935.18	100.00
Family labour cost	26384.00		24262.36	

***Health management*:** Surra (tibersa) is the most common disease in camel and breeders vaccinate the animals to protect them from this disease. Mange (pam) is also one of the important diseases whose treatment is given based on appearance of symptoms. Some other diseases prevalent in camel were abortion, camel pox (mata), ectoparasites (ticks), wound with maggot, enteritis, lantana poisoning, eye laceration, pica (sand licking) and rumen impaction etc. Saini *et al*. (2006) observed that mange was most prevalent; however, surra was reported by only few. Treatment of the common ailments of camel is carried out by breeders themselves following ethno veterinary practices. For treatment of few health problems 'hot iron branding' (dam) is also given by expert breeders who is skilled in this practice. It was found during field surveys that delay in proper treatment was also one of the major causes of mortality in camel.

Cost and returns in camel production

Fixed cost: Average fixed cost worked out per year for a camel herd in western and southern Rajasthan was Rs. 94049 and Rs. 52277, respectively. The interest component had two third shares in the total fixed cost. The fixed cost of the animals was the major item of fixed cost due to comparatively higher investment on animals (Table 3). These results were in contrary to bovines where farmers spend considerable amount on animal sheds and utensils and that also contributes significantly to fixed cost.

***Maintenance cost*:** The average cost of maintaining a camel herd in western Rajasthan (37 animals) and southern Rajasthan (21 animals) was Rs. 137119 and Rs. 102935, respectively. The proportion of fixed cost was more than 50 percent in total cost of maintaining a camel

herd. The higher share of fixed cost was contrary to bovines where variable cost has higher share in the total cost as these animals are stall fed while in case of camel management animals are more dependent on common grazing lands for feeding and labour was the major component with more than 22 percent share in the total cost (Table 4).

***Returns*:** Average net return worked out per herd per year was Rs. 7147 and Rs. 101451 in western and Southern Rajasthan, respectively (Table 5). The B: C ratios of 1.05 and 1.99 indicated that camel rearing was a profitable venture in both the regions. Maximum share in the returns was sale of animals in western Rajasthan, while in southern Rajasthan it was value of milk sold in market. Camel breeders usually sell male calves of more than one year old to fetch better price. Rajput and Tripati (2009) reported that the income of majority of the respondents (55%) ranged between Rs. 3000 to Rs. 5000 per month; about 13% of the families had their earning even less than Rs. 3000, which indicated low income status of camel rearing households. These findings indicated significant opportunity to sell camel milk as camel breeders in southern Rajasthan had more than 50 percent contribution from camel milk in the gross earnings from this enterprise.

Financial viability of camel production

The financial viability analysis of camel production indicated a payback period of four to eight years. The camel production was financially viable at 12 per cent discount rate in terms of both NPV and BCR criteria, as NPV was positive and BCR greater than one. The IRR that indicates the maximum paying capacity of the camel rearing was estimated to be double in southern region compared to western region due to higher gross returns per year. It implies that it would be financially viable to invest in camel production. The annuity value of camel production was Rs. 173325/- and Rs. 329299/- in western and southern region, respectively, which indicated income generating capacity of the camel enterprise (Table 6). Gross B: C ratio calculated was also found higher than unity confirming that camel breeding enterprise was profitable in both regions. Thus based on different criteria it ws observed that traditional camel rearing enterprise despite several hardships to breeders was financially viable in both the regions of Rajasthan. However, the small ruminant rearing is quite attractive alternative as compared to camel rearing in western Rajasthan (Kumar and Upadhyay, 2009). Hence, there is a need for appropriate strategies to increase net returns from camel production for its sustainability.

Table 5. Returns from camel (Rs./ herd/ yr)

Particulars	Western Rajasthan		Southern Rajasthan	
	Amount (Rs.)	Percent	Percent	Amount (Rs.)
A. Sale of animals and value addition in calves	115317	79.93	70276	34.38
B. Other income	28949	20.07	134123	65.62
Milk value	9511	6.59	107913	52.80
Income from wool	10602	7.35	3074	1.50
Estimated food value received free from farmers	8006	5.55	19200	9.39
Camel dung value	830	0.57	3,935	1.93
C. Gross returns	**144266**	**100.00**	**204386**	**100.00**
Total variable cost	43,070		50,658	
Fixed cost	94,049		52,277	
D. Total cost	**137119**		**102935**	
E. Net returns	**7147**		**101451**	
F. Returns over variable cost (ROVC)	101196		153728	
G. B:C ratio	1.05		1.99	
H. Family labour income	33531		125713	

Table 6. Measures of investment worth per camel herd (Rs.)

Particulars	Western Rajasthan	Southern Rajasthan
Pay-back period (years)	8.00	4.00
Net present value (NPV) at discount rate of 12 percent (Rs.)	1208764	2344485
Internal rate of return (IRR) (%)	27.55	55.73
Annuity value at 12 percent discount rate	173325	329299
Gross benefit-cost ratio (BCR) at 12 percent discount rate	1.80	3.07

Conclusion

The traditional camel breeding enterprise in western and southern Rajasthan was found to be profitable and important source of gainful employment for camel breeding households, but it was less attractive on account of drudgery involved. The changing social dynamics and scarcity of feed resources from commons are the other major drivers of this change. However, due to better access to market for camel milk in southern Rajasthan its net returns were higher compared to western region. The restriction on entry of camel in the forest areas is another major constraint for camel breeding, especially during rainy season as the options for grazing in this season are very limited. There is an urgent need for a strategy for enhancing sustainability of the camel breeding enterprise which is important to meet the critical demand for these special animals used by army, farmers and carters in the sandy terrains in western India. The measures like sustainable management of degraded common pasture, enhanced opportunities to sell camel milk through mobile milk collection vans using cooperative network and provision of mobile veterinary facility by state animal husbandry department in camel breeding areas etc expected to help in improving socio-economic condition of camel breeders.

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