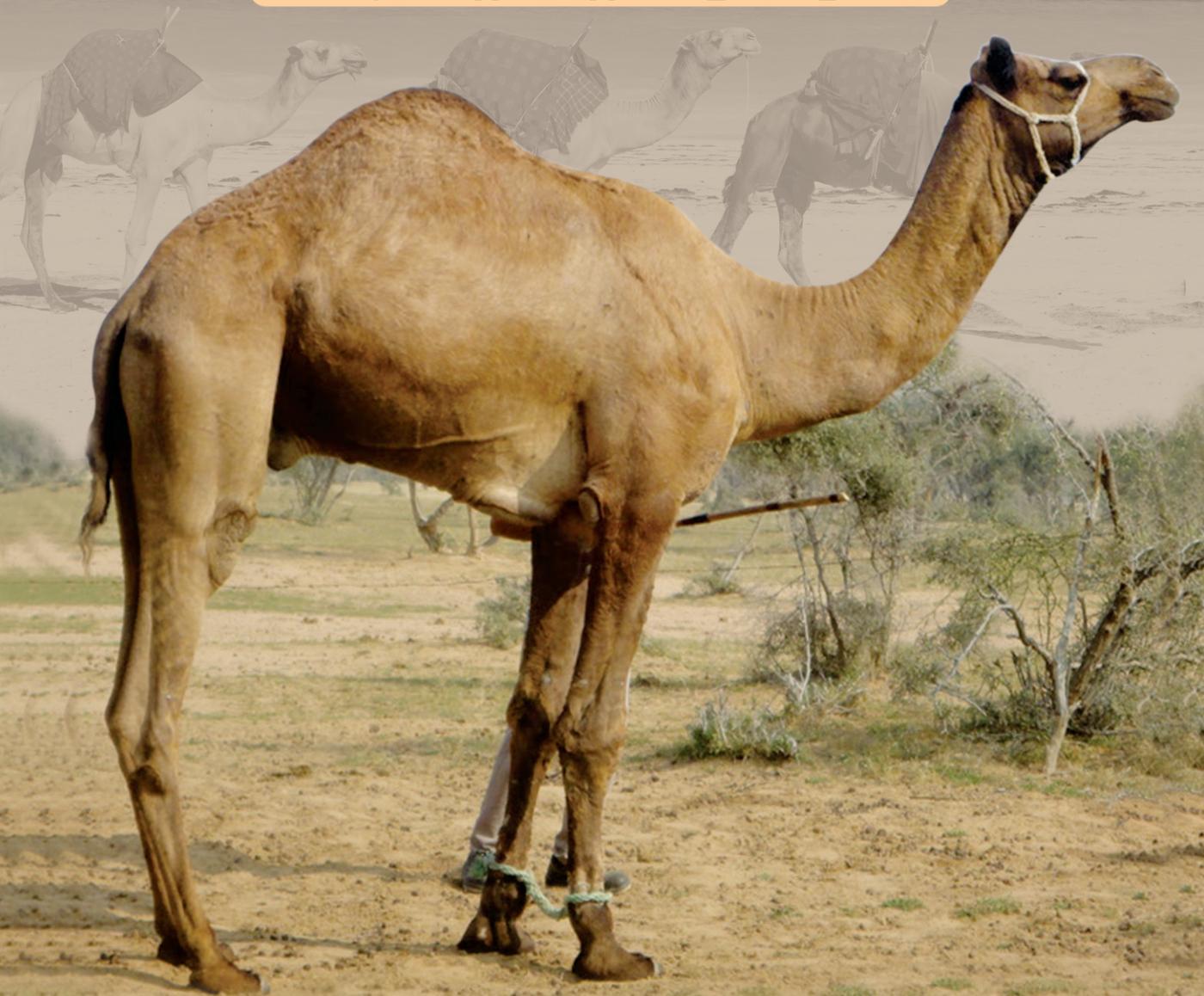


CAMEL GENETIC RESOURCES OF INDIA

MARWARI

C A M E L



ICAR-NATIONAL RESEARCH CENTRE ON CAMEL

Post Box-07, Bikaner-334001 (Rajasthan) India



Camel Genetic Resources of India

MARWARI

— • C A M E L • —

Ved Prakash, R. K. Sawal, Rekha Sharma,
M. S. Tantia and A. Sahoo



**Network Project on AnGR
Characterization of Marwari Camel**



ICAR-National Research Centre on Camel

Post Box No-07, Bikaner-334001 (Rajasthan)



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PREFACE

The desert state of Rajasthan is identified best with camel. This iconic animal is now the state animal of Rajasthan. By virtue of several adaptive features, it has served the mankind for centuries under harsh climatic conditions. Though, the traditional use of camel for long distance travel and trade is on decline but its use in ecotourism and dairy has increased significantly. The use of camel in local transportation of goods, in the religious and ceremonial processions and by the border security force of the country is still continuing and contributing to its sustenance. In recent years camel has been recognized as emerging non-bovine dairy species due to multiple therapeutic uses of its milk.

India has nine registered camel breed and around 28% of the camel population is still non-descript. Even among the registered camel breeds, breed like Marwari does not have well documented breed characteristics. The present work is an attempt to characterise the breed and document its production characteristics keeping in mind the changing utility of camel in existing agricultural setup. Though other utility of the breed is on decline but its milk production potential can be successfully exploited to improve the utility of this breed and ensuring the livelihood security of the Marwari camel herders.

The success of any programme depends on the team. The support received from Co-PI Dr. R. K. Sawal, Pr. Scientist and Project supervisors Sh. Gajanand, Rajendra Kumar, Amit Kumar, Danaram, Arjun Kumar and Jaskaran Dan, officers of Animal Husbandry Department, enumerators and the camel owners is highly acknowledged. The All India Radio team of “Untan Ri Bataan” programme and all experts who delivered their talks deserve hearty appreciation.

Sincere thanks are due to the higher authorities of Indian Council of Agricultural Research, New Delhi for sanctioning the project and to Dr. M.S. Tantia, PS & In-charge, Dr. Rekha Sharma, Dr. Rahul Behl, Dr. K. N. Raja, Dr. Arjava Sharma, Ex Director, Dr. R.K.Vijh, Ex-Director and Dr. B.P. Mishra, Director, ICAR-National Bureau of Animal Genetic Resources, Karnal for the support extended in the execution of the project. The Director, scientists, all officers and staff members of ICAR-National Research Centre on Camel, Bikaner who have extended their whole hearted support in successful execution of the project, is duly acknowledged.



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MARWARI

• C A M E L •

INTRODUCTION

The camel is ideally suited to desert life and is found in hot as well as cold deserts. According to the zoological classification, camel, llama, alpaca, guanaco and vicuna constitute one family, *camelid*. The camelids belong to order *Artiodactyla* (even-toed ungulates), sub-order *Tylopoda* that represents, camelids as ruminating animals. It is classified in proximity to ruminants but are not part of the suborder *Ruminantia*. Differences such as foot anatomy, stomach system and the absence of horns confirm this fact (Schwartz and Dioli, 1992; Fowler, 1998; Wernery, 2003). They are pseudo ruminants, have no horns, and have an elongated neck, a longish head, a split upper lip and feet in the shape of broad pads. The genus *Camelus* has two species, the one-humped camel found in Africa, Arabia, Iran, Afghanistan and India and two-humped camel found in Central Asia reaching up to Mongolia and western parts of China. It is a multipurpose animal and used for milk, meat, hides and transport. According to Rathore, (1986), the word ‘camel’ is derived from the Greek word *Kremal*. The Greeks borrowed this word from the original Sanskrit word *kreluk* which means “throwaway legs”. This word might have been given to the camel in Sanskrit because when camel runs he actually throws out his legs in the air and has very little control over them. In Hindustani the camel is called *oont* and in Persian *ustra*. Both these words are borrowed from the Sanskrit word *ustra*, which literally means “over blacked colour” that is blackish brown. The name of the dromedary is derived from the Greek, “dromeus” which means runner or drama means running (Jassim and Naji, 2002). The Egyptians called it ‘evil animal’ probably because all the invaders during ancient days came on camel back from Arabia to Egypt (Rathore, 1986).

Many researchers indicated that the origin of camels can be traced to the *Protylopus*, a rabbit sized animal with four toed feet and low crowned teeth that occupied the North American continent during the eocene period or 45-50 million years ago (Indra et al., 1998). Around 35 million years ago, camelids such as *poebrotherium* were about the size of a present day goat. The family diversified and prospered but remained confined to the North American continent until only about 2-3 million years ago, when representatives arrived in Asia and South America. The one humped or dromedary camel (*Camelus dromedarius*) reaches the eastern limit of its continuous distribution area in the Indian subcontinent.

To determine which regional types of camels should be classified as “breed” is not only a question of grouping them according to physical and/or performance characteristics; valuable clues can also be retrieved from an examination of the socio-historical context in which camel breeding was practiced in India (Kohler-Rollefson, 1992a). Many non-literate pastoral societies have developed distinct breeds because of social mechanisms which preclude the commercial sale of breeding stock, essentially leading to a well demarcated and stable gene pool (Kohler-Rollefson, 1992b). In India there were several regional situations in which camel subpopulations were sequestered and distinct breeds could develop. Before the camel became popular as a draught animal, the breeding and ownership of camels was largely restricted to only two castes, the Rajputs and Raikas. Evidences for involvement of Sindhi trader community in long-distance commerce and the caravan trade also indicates towards their interest in camel ownership. The Rajputs, composed of the ruling elite of Maharajahs, Rajas and lesser feudal landowners, required large numbers of camels for warfare among themselves and against Muslim invasions. For this purpose, the majority of the states of Rajputana, including Bikaner, Jaisalmer, Jodhpur and Jaipur maintained camel corps. The Rajputs employed members of a specialized caste, the Raikas, to look after their tolas or camel breeding herds (Kohler-Rollefson 1992a; Srivastava, 1991). Even after the feudal system was abandoned and the royal camel tolas were dispersed at the beginning of the 20th century, many of the Raikas continued their camel breeding tradition, and today most large scale camel breeding is still practiced by them.

The camelids occupy most difficult lands on the earth and hence they have developed several unique adaptive features for survival. Some of the important features are:-

1. They have a three-chambered rather than a four-chambered digestive tract.
2. The upper lip splits in two, with each part separately mobile.
3. They have single domain antibodies (also known as nanobodies or VHHs) which lack a light chain and are composed of two identical heavy chains.
4. They have padded foot (*Tylopoda*) instead of hooves.
5. They have long eyelashes and the unique ability of closing their nostrils to face sandstorms.
6. They can fluctuate their body temperature to avoid excess perspiration and have specialized kidneys, which make them able to tolerate even more than 30% water loss.
7. They have non-nucleated but oval shaped Red Blood Cells (Erythrocytes).
8. They can go days without drinking water, surviving extreme dehydration and safely losing 40% of its body weight.
9. Their Red Blood Cells are capable of expanding up to 240% of their original volume without rupturing, whereas most animals' cells can expand only up to 150%.

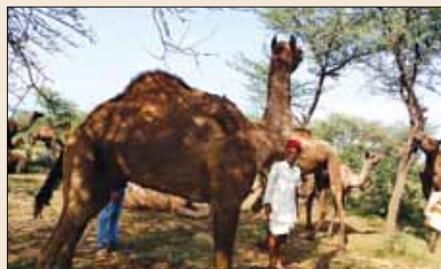
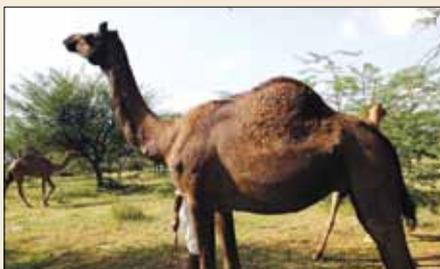
According to Faye, (2020) there are officially 46 countries in the world declaring camel stock, of which 20 countries are in Africa, 25 in Asia and one in Europe (Ukraine). The dromedaries are found in African countries and in near and Middle Eastern and Southern Asian countries, and the bactrians inhabit Central Asia. The two species, however, are cohabiting in a few countries only, mainly in Kazakhstan. The total number of camels recorded in the world was more than 3.5 million (FAOSTAT 2020). As per National Bureau of Animal Genetic Resources (NBAGR), Karnal (India) has nine registered breed namely Bikaneri, Jaisalmeri, Marwari, Jalori, Mewari, Mewati, Kachchhi, Kharai and Malvi. Since the population of camel in India has gone down from its ever highest of 1.10 million in 1977 to 0.25 million in the year 2017, several of the camel rearing tracts now possess very few animals without any breeding group. The dwindling camel population in the country is a matter of major concern for the conservation biologist, policy makers and the state governments. Still, the efforts of the Indian Council of Agricultural Research-National Bureau of Animal Genetic Resources, Karnal has helped the scientists to reach those areas which were not covered earlier. This has helped scientist to identity new population and in future it can be hoped that 28% of non-descript camel population will be fully described and a zero non-descript status may be achieved.

ORIGIN OF MARWARI CAMEL

In India, camel breeds are mainly named after the region in which they have originated. The Marwari camel derives its name from Marwar region. The ruling family of Marwar, the biggest state of Rajputana, maintained camel corps which was deployed in their frequent military campaigns, and on occasion it was lent out to the Mughal emperors in Delhi (Saxena, 1989).

According to Kohler-Rollefson (1992a), camels for the Maharajah army were supplied by the Raikas of a number of villages in the vicinity of Jodhpur (including Salawas, Khejerli, Kharda, and Binaikia). The Marwari camel tends to be of medium height, medium build, and of fairly dark color (Kohler-Rollefson, 1992b). It does not appear to represent as distinct a type as the camels of Jaisalmer or Bikaner. In Bikaner or Jaisalmer states camel breeding was concentrated in a few Raika settlements but in Marwar it was a much more dispersed activity. Camel breeding was not just a matter of royal patronage, but was also pursued by the Rajputs that composed the landed gentry. Marwar is the original home of the Raikas where they are most densely concentrated. It is likely that they supplied camels as pack animals to the trading community in addition to the Rajput armies. The main trade route and traffic artery from Delhi and Agra to the Gulf of Cambay passed through Marwar, and in addition to ox-carts, camels were the main means of transportation. The Raikas have marriage relations only between certain villages. The reciprocal transfers of camel took place between the families of these villages which consolidated the gene pool and led to development of several quite distinct local breeds including dark brown Marwari Camel (Kohler-Rollefson, 1992b)

According to (Khanna et al., 2004) Marwari camels are found in the Marwar area specifically in Jodhpur, Jalore, Barmer districts of Rajasthan. They have heavy built with long legs, muscular body and are good for agricultural operations. These animals resemble Bikaneri in several body confirmations except facial characteristics which is at variance.



GEOGRAPHICAL DISTRIBUTION AND BREEDING TRACT

The geographical distribution of the breed encompasses chiefly the Marwar region of Rajasthan. Marwar (also called Jodhpur region) is a region of south-western Rajasthan in north-western India. It lies partly in the Thar desert. The region includes the present day districts of Barmer, Jalore, Jodhpur, Nagaur, Pali and parts of Sikar. Distribution of the breed is now mainly confined to Pali, part of Jodhpur and Barmer. However, some herds of this breed can be found in Jaisalmer, Sirohi and Jalore also. The breeding tract of Marwari camel is contiguous with area of Jaisalmer in north-west, Bikaner, Churu and Sikar in north, area of Sirohi district in south and Udaipur and Rajasmand district in south west. Thus breeding tract of Marwari camel shares boundaries with Jaisalmeri, Bikaneri and Mewari breed breeding tract.

Marwar is a sandy plain lying northwest of the Aravalli range, which runs south-west-northeast through Rajasthan state. The Aravallis bring much of the moisture from the south-west monsoon. Annual rainfall is low, ranging from 10 cm to 40 cm. Temperature ranges from 48 to 50°C in the summer, to below freezing point in winter. The north-western thorn scrub forests lie next to the Aravalli range, while the rest of the region lies in the Thar Desert. The Luni river is the principal feature of the Marwar plains. It originates from the Pushkar valley of Ajmer district, and the main river flows through Marwar in a south-westerly direction until it finally disappears into the seasonal wetland of the Rann of Kutch in Gujarat. It is fed by tributaries that flow from the Aravallis.

Irrigation from the river, and from wells near the river, support crops of wheat and barley. The sandy tracts of Thar desert in western Marwar (Maru Pradesh) are characterized by a harsh physical geography and a fragile ecology. High wind velocity, shifting sand dunes and very deep and saline water sources pose a challenge to sustained human habitation in the Thar. The area is prone to devastating droughts. The Thar desert is one of the most inhospitable landscapes on earth. Apart from the huge distances between hamlets and settlements here, the landscape is constantly shifting with the sand, as wind and sandstorms rearrange the landscape.

Extent of survey

Breed characterization is an integral part of conservation because only after proper characterization the availability of breeding males, females and the population of a breed can be estimated. Hence, to assess the true picture of the breed, the Marwar area was surveyed. The survey work was carried out in 169 households covering 87 villages of 23 tehsils covering 6 districts of the breeding tract (Table-1).

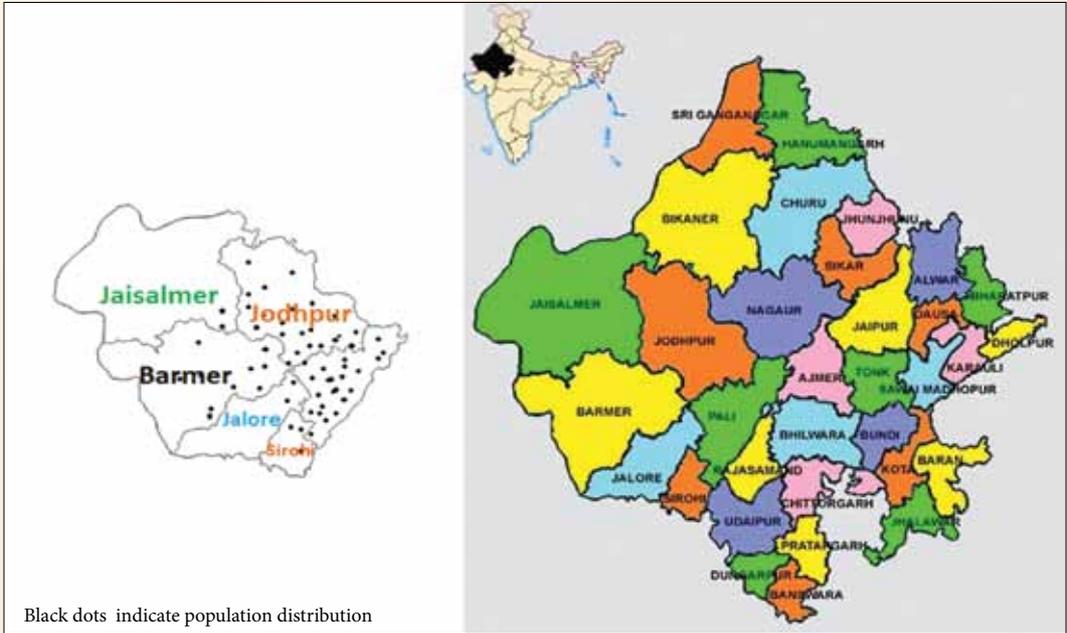


Figure 1: Current status of Marwari camel population distribution

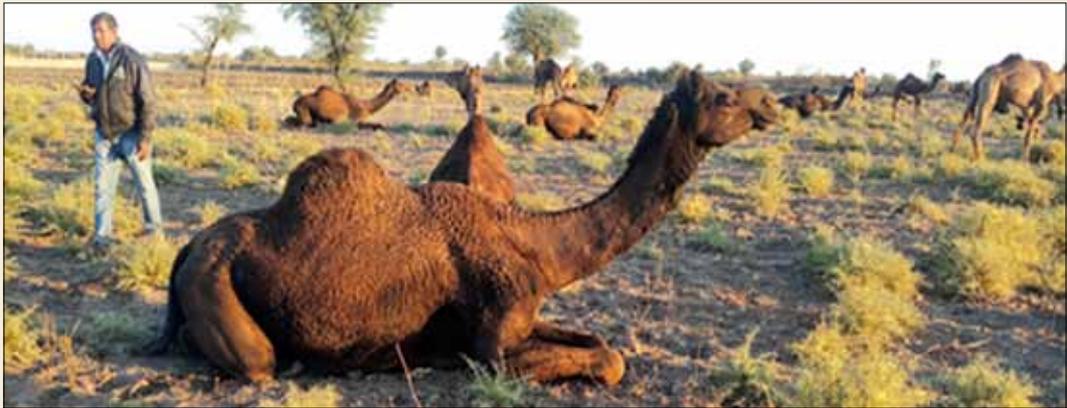


Table 1: Extent of survey for characterization of Marwari camel

S. No.	District	Tehsil	No. of Villages	No of farmers
1.	Pali	Desuri	11	14
		Marwar Junction	3	6
		Pali	8	9
		Rani	15	26
		Rohat	1	1
		Sojat	1	1
		Sumerpur	1	1
2.	Sirohi	Pindwada	4	8
		Abu road	1	1
3.	Jodhpur	Balesar	10	17
		Phalodi	4	12
		Luni	4	11
		Osian	3	4
		Shergarh	3	4
		Tinwari	1	2
		Jodhpur	2	6
4.	Jaisalmer	Pokhran	1	5
5.	Jalore	Ahore	1	1
6.	Barmer	Barmer	4	8
		Gida	1	2
		Pachpadra	5	15
		Shiv	1	2
		Sindhari	2	13

Socio-Economic Profile

The Marwari camel farmers are mostly from Dewasi/Rewari community (90%). Only 10% farmers belonged to other community like Jaat, Bishnoi, Muslim, Prajapat and Rajput. Average family size was of 7.97 with average composition of 2.09 adult male, 2.05 adult female, 2.14 male child and 1.68 female child. The family size was highest in Jodhpur district (9.58) and lowest in Barmer district (6.06). Literacy level was poor among Marwari camel farmers. Around 89.35% were illiterate of which, 54.92% were able to put signature. Only 10.65% were 10th pass and above. A total of 30.30% Marwari camel farmers were landless and 69.70% have land. The 96.52% of the farmers with landholding possessed non-irrigated land. Average landholding of landed farmers was 15.26 bigha and per household it was 10.64 bigha. Main source of income was agriculture (88.31%) and animal husbandry (97.40%). Some of the farmer (10.38%) also worked as a labour. Many farmers are keeping camels even without any substantial profit to maintain the heritage of his family.

More than 32% of the camel owners rear cattle, 65% rear sheep and 68% rear goat (Table-2). Average camel herd size was about 25 which varied between different districts. Herd size is highest in Jodhpur and lowest in Pali (Fig-2). In the Pali and Sirohi region the camels are being reared for milk production. Sale of camel milk is the chief source of income to the breeders in the Pali area. However, in the other parts of breeding tract like Barmer and Jodhpur the camel has limited uses. Some of the farmers are using it for carrying load and also earning income through the sale of extra male animals. The use of camel for domestic purpose and in tourism adds to the income of camel breeders. The use of camel hairs for preparation of items of domestic use contribute to indirect income of the camel owners. Due to frequent change of place or continuous migration of the camels, the life of the accompanying person is very difficult and this is why the young generation is not opting camel husbandry. Many farmers does not have income through it but they continue to rear it as their forefathers were associated with it.



Table 2. Livestock species reared by the Marwari camel owners

S.No	Districts	No. of House hold	Cattle	Sheep	Goat	Camel
1	Barmer	40	101 (27)	363 (21)	513 (31)	799 (40)
2	Jaisalmer	05	17 (5)	50 (02)	60 (04)	139 (05)
3	Jalore	01	-	80 (01)	20 (01)	20 (01)
4	Pali	58	07 (04)	3162 (39)	963 (38)	893 (58)
5	Sirohi	09	13 (08)	5 (01)	7(02)	181 (09)
6	Jodhpur	56	29 (11)	1337 (46)	563(39)	2219 (56)

Value in parenthesis indicate no. of household

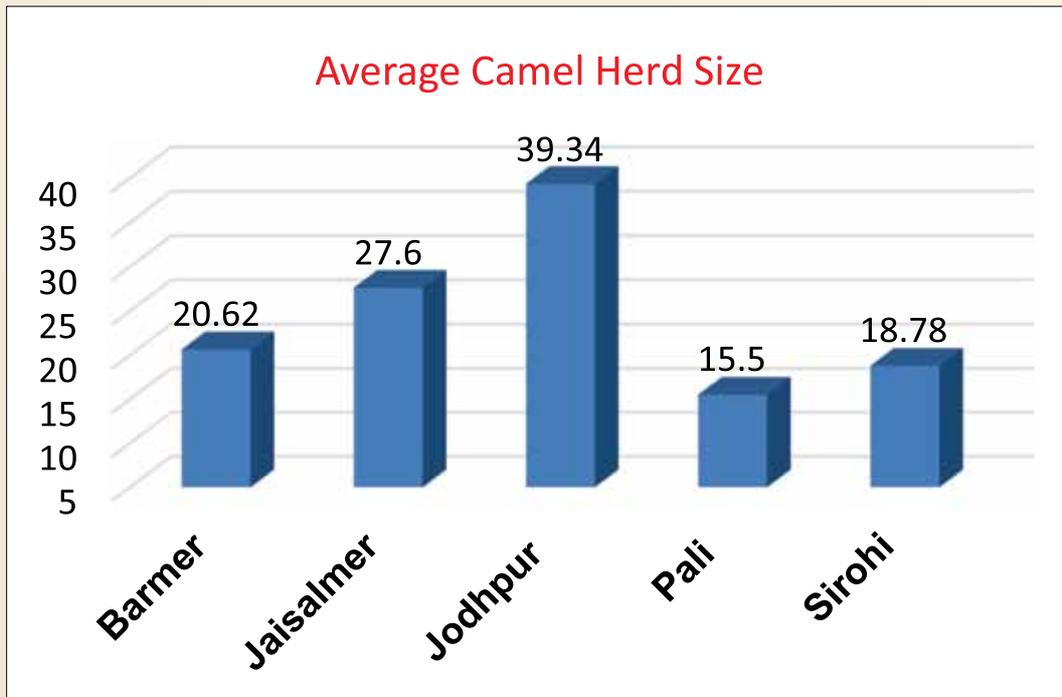


Figure 2: Average herd size of Marwari camel



Age-wise and Sex-wise distribution

The status of a particular breed with respect to its age-wise and sex-wise distribution in different area of the breeding tract is very important. Among the 6 districts in which survey work was carried out, Sirohi, Jalore and Jaisalmer have limited households with Marwari camel. Marwari breed is mostly present in Pali, Jodhpur and Barmer district and covered 95% of the survey villages. Even in these three districts presence of the Marwari breed population varied. Marwari breed population was more in Pali and Jodhpur district. In the Barmer district the Marwari breed population was present in the area bordering the Jodhpur district. The Marwari herd has other breed camel population. In the Pali region Marwari herd had animals of Mewari breed and Bikaneri crosses. In Pali region 87.67% camel population was of Marwari breed. In the Jodhpur and Barmer region herd has some animals of Jaisalmeri breed or Bikaneri crosses. In the surveyed herds of Jodhpur (90.72%) and Barmer (94.38%) animals were of Marwari breed. The morphometric traits were recorded for 1324 camels. Individual camel was judged for the breed characteristics. In the present survey the ratio of breedable males to females was around 1:10. The age-wise and sex-wise population of Marwari camels covered under the survey is presented in Table 3, 4 and 5 below.

Table 3: Age wise and sex-wise camel population with Marwari camel owners

Age Group	≤1 years			1-4 years			Above 4 years			Over all		
Category	Marwari	Others	Total	Marwari	Others	Total	Marwari	Others	Total	Marwari	Others	Total
Male	335	94	429	337	88	425	183	34	217	855	216	1071
Female	366	104	470	570	92	662	1777	271	2048	2713	467	3180
Total	701	198	899	907	180	1087	1960	305	2265	3568	683	4251

Table 4: District-wise distribution of Marwari male camel population

Age Group	≤1 years		1-4 years		Above 4 years		Total	
Category	Marwari	Others	Marwari	Others	Marwari	Others	Marwari	Others
Barmer	52	5	80	12	49	8	181	25
Jaisalmer	3	3	14	1	4	1	21	5
Jalore	2	-	2	-	4	-	8	0
Jodhpur	171	52	158	42	84	20	413	114
Pali	95	30	71	31	36	5	202	66
Sirohi	12	4	12	2	6	-	30	6
Total	335	94	337	88	183	34	855	216

Table 5: District-wise distribution of Marwari female camel population

Age Group	≤1 years		1-4 years		Above 4 years				Total	
	Marwari	Others	Marwari	Others	Dry		Lactating		Marwari	Others
Marwari					Other	Marwari	Others			
Barmer	70	17	187	20	128	17	148	6	533	60
Jaislamer	13	-	19	-	56	-	25	-	113	0
Jalore	1	-	3	-	5	-	3	-	12	0
Jodhpur	161	55	248	49	451	87	569	72	1429	263
Pali	101	30	92	21	144	34	158	45	495	130
Sirohi	20	2	21	2	49	7	41	3	131	14
Total	366	104	570	92	833	145	944	126	2713	467

BREED CHARACTERISTICS

Body colour

The physical appearance of any animal is chiefly defined by the body colour followed by stature and other phenotypic characteristics. The predominant colour of Marwari camels is brown. However, it varies from sand brown to dark brown. When the calves are born, the body colour is generally lighter and the hairs are curly. The body colour gets darker and the curls open with age.

Head Profile

The head in Marwari camel is small to medium in size and well carried on a thin neck. Fore head is normal /flat. Lips are normal. The supraorbital foramen, which is in the form of a deep fissure at the rostra medial margin of the orbit, is normal in depth. They have small erect ears which are slightly curved inwards .

Body and stature

The Marwari camels have medium to large body size. They have active temperament. The hump is medium in size. Chest pads are well developed. The body hairs are coarse in quality and medium in length.

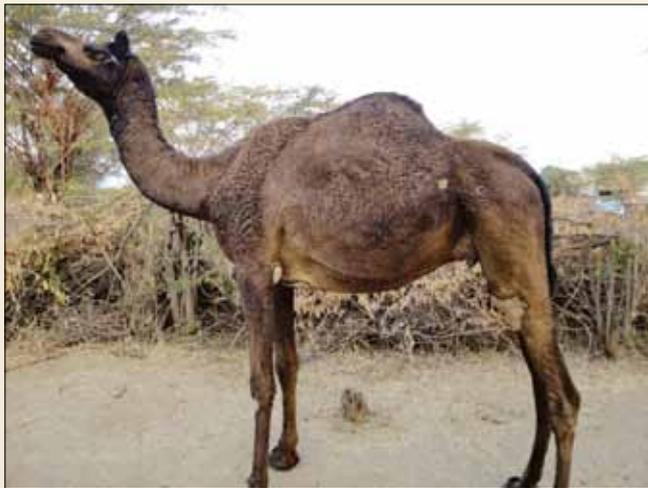
Udder Characteristics

The animals have good milk yield potential. Round as well as pendulous udder is found in the Marwari camel. However, more animals have round udder. There are four quarters and each quarter has mostly cone shaped teats. They have well developed milk veins of medium to large size.

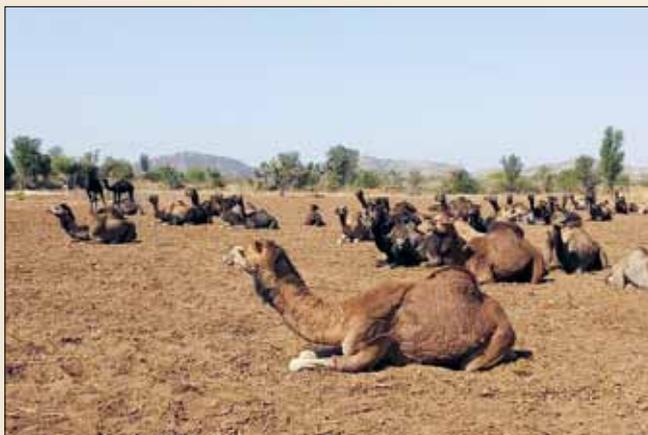




Marwari Male



Marwari Female



Marwari Herd

MORPHOMETRIC CHARACTERISTICS AND GROWTH PROFILE

Body Measurements

The camels of four year and above age are considered adult as the females as well as the males attain puberty. At this age the permanent incisors starts erupting. However, the camels continue to gain weight significantly till eight year of age, which is generally noticed by the presence of prominent canines in the mouth. Looking at the length of growth phase, the morphometric traits have been presented separately for the calves (up to one year age), followed by adolescent camels (1 to 4 years of age) and then for adult male and female camels of above four year age (Table 6-8).

Table 6: Morphometric measurement (cm) of Marwari camels (≤ 1 year age)

S.N.	Characters	Female (114) Mean \pm S E	Male (148) Mean \pm S E	Overall (262) Mean \pm S E
1	Heart girth	128.74 \pm 1.99 (94-170)	136.24 \pm 1.69 (96-180)	132.98 \pm 1.31 (94-180)
2	Body length	88.74 \pm 1.41 (55-120)	93.62 \pm 1.20 (66-145)	91.50 \pm 0.96 (55-145)
3	Height at wither	142.81 \pm 20 (70-180)	148.50 \pm 1.78 (70-191)	146.02 \pm 1.35 (70-191)
4	Tail length	36.63 \pm 0.47 (28-49)	37.32 \pm 0.54 (26-65)	37.02 \pm 0.37 (26-65)
5	Neck length	70.15 \pm 1.04 (40-100)	72.32 \pm 0.79 (52-105)	71.38 \pm 0.64 (40-105)
6	Face length	26.79 \pm 1.04 (16-40)	27.94 \pm 0.34 (20-30)	27.44 \pm 0.27 (16-40)
7	Distance between eyes	15.14 \pm 0.20 (10-22)	15.55 \pm 0.17 (11-22)	15.37 \pm 0.13 (10-22)
8	Ear length	5.97 \pm 0.18 (3-11)	5.74 \pm 0.15 (2-11)	5.84 \pm 0.11 (2-11)
9	Fore leg length	109.34 \pm 1.01 (55-128)	114.11 \pm 0.98 (60-140)	112.21 \pm 0.72 (55-140)
10	Hind leg length	119.34 \pm 0.99 (60-143)	124.09 \pm 0.92 (72-170)	122.02 \pm 0.61 (60-170)
11	Foot pad(L/W)			
	Fore leg (length)	11.91 \pm 0.17 (8-18)	12.45 \pm 0.14 (9-18)	12.22 \pm 0.11 (8-18)
	Fore leg (width)	12.34 \pm 0.19 (8-18)	12.82 \pm 0.17 (8-18)	12.61 \pm 0.13 (8-18)
	Hind leg (length)	11.90 \pm 0.19 (8-16)	12.46 \pm 0.18 (8-18)	12.23 \pm 0.12 (8-18)
	Hind leg (width)	12.30 \pm 0.24 (6-18)	12.92 \pm 0.23 (7-19)	12.65 \pm 0.17 (6-19)

(Value in parenthesis are range values)

Table 7: Morphometric measurement (cm) of Marwari camels (1 to 4 year)

S.N.	Characters	Female (139) Mean± S E	Male (107) Mean± S E	Overall (246) Mean± S E
1	Heart girth	188.08±1.16 (130-216)	186.02±1.86 (100-227)	187.19±1.04 (100-227)
2	Body length	143.67±1.19 (92-170)	144.94±1.97 (72-196)	144.22±1.09 (72-196)
3	Height at wither	188.42±0.88 (160-210)	184.43±1.45 (122-216)	186.69±0.81 (122-216)
4	Tail length	46.97±0.52 (30-60)	47.32±0.56 (32-67)	47.12±0.52 (32-67)
5	Neck length	103.04±1.17 (65-130)	105.25±1.56 (62-141)	104.00±0.95 (62-141)
6	Face length	38.56±.56 (23-54)	39.97±0.58 (22-50)	39.17±0.41 (22-54)
7	Distance between eyes	20.04±0.20 (13-28)	20.64±0.25 (10-26)	20.30±0.16 (10-28)
8	Ear length	7.73±0.20 (4-12)	8.30±0.27 (3-13)	7.98±0.16 (3-13)
9	Fore leg length	140.19±0.61 (108-158)	138.53±0.92 (99-160)	139.47±0.53 (99-160)
10	Hind leg length	151.42±0.74 (116-188)	151.24±1.13 (118-180)	151.35±0.65 (116-188)
11	Foot pad(L/W)			
	Fore leg (length)	18.52±0.14 (13-21)	18.69±0.25 (9-26)	18.59±0.13 (9-26)
	Fore leg (width)	18.64±0.15 (12-23)	18.38±0.21 (10-24)	18.52±0.12 (10-24)
	Hind leg (length)	18.19±0.14 (12-22)	17.95±0.22 (10-24)	18.09±0.12 (10-24)
	Hind limb (width)	18.40±0.19 (11-24)	17.69±0.23 (8-24)	18.09±0.15 (8-24)

(Value in parenthesis are range values)

Table 8: Morphometric measurement (cm) of adult Marwari camels

S.N.	Character	Female (731) Mean± S E	Male (85) Mean± S E	Overall (816) Mean± S E
1	Heart girth	216.86±0.50 (129-250)	221.16±1.54 (151-248)	217.31±0.48 (129-250)
2	Body length	165.27±0.39 (102-201)	169.08±1.60 (92-195)	165.67±0.39 (92-201)
3	Height at wither	202.37±0.54 (96-268)	200.96±1.73 (129-250)	202.22±0.52 (96-268)
4	Tail length	57.02±0.21 (35-78)	59.32±0.74 (30-74)	57.26±0.21 (30-78)
5	Neck length	119.93±0.38 (56-156)	118.62±1.06 (70-141)	119.79±0.36 (56-156)
6	Face length	45.72±0.21 (30-60)	46.33±0.61 (32-67)	45.78±0.20 (30-67)
7	Distance between eyes	23.79±0.08 (13-35)	23.94±0.26 (12-28)	23.80±0.07 (12-35)
8	Ear length	10.44±0.09 (3-18)	10.87±0.28 (4-17)	10.48±0.09 (3-18)
9	Fore leg length	147.68±0.22 (120-170)	148.04±0.82 (114-166)	147.71±0.22 (114-170)
10	Hind leg length	162.78±0.28 (128-192)	166.11±1.11 (121-182)	163.12±0.28 (121-192)
11	Foot Pad(L/W)			
11a.	Fore leg (length)	21.39±0.06 (13-26)	21.66±0.21 (13-26)	21.41±0.06 (13-26)
	Fore leg (width)	21.01±0.06 (10-25)	20.94±0.18 (14-24)	21.00±0.06 (10-25)
11b.	Hind leg (length)	20.44±0.07 (12-25)	20.48±0.20 (14-24)	20.45±0.06 (12-25)
	Hind leg (width)	20.11±0.09 (11-28)	19.87±0.26 (15-25)	20.08±0.09 (11-28)

(Value in parenthesis are range values)

Body Weight

Growth profile of an animal is considered as index of its health, production and reproduction. Thus, maintenance of proper body weight is essential for work performance as well as milk production. In the field conditions actual body weight measurements were not possible hence body weight (Table-9) was calculated by the formula suggested by Wilson (1978).

Body weight (Kg)= $[507 \times \text{Chest Girth (m)} - 457]$

Table 9: Body weight (Kg) of Marwari camel

Age group	Male Mean± S E	Female Mean± S E	Overall Mean± S E
Up to 1 year	233.78±8.58 (148)	195.76±10.14 (114)	217.24±6.64 (262)
1-4 year	486.14±9.43 (106)	496.68±5.88 (139)	492.72±5.27 (245)
Adult	664.38±7.83 (085)	642.46±2.57 (729)	644.75±2.45(814)

Values in parenthesis indicate number of animals



MOLECULAR CHARACTERIZATION

Genetic Variability

The molecular characterization of Marwari camel was done using microsatellite markers. A battery of 25 microsatellite markers was used to estimate the genetic variability of Marwari camel population. All the microsatellite loci amplified unambiguously and a total of 202 alleles were detected across the 25 loci. An exact test for genotypic linkage disequilibrium yielded no significant P values across the population, and therefore independent assortment of all the loci was assumed. Reasonable polymorphism in Marwari camel was evident from the allele frequency data. Among the loci, VOLP67 displayed the highest (24) and VOLP08 displayed the lowest (3) number of observed alleles in Marwari camel. Expected number of alleles varied from 1.596 (VOLP08) to 8.486 (VOLP67) with mean of 3.861 ± 0.368 (Table-10).

Shannon's Information Index (I) is a parameter, indicative of the informativeness of a marker ranged from 0.621 (VOLP08) to 2.601 (VOLP67)) (Table-10). Marwari camel had moderate but sufficient genetic variation based on its gene diversity, in addition to the average number of alleles per locus. The observed and expected heterozygosity values ranged from 0.130 (YWLL09) to 0.915 (CMS50) and from 0.373 (VOLP08) to 0.882 (VOLP67) with an overall mean of 0.564 ± 0.045 and 0.682 ± 0.029 , respectively (Table-10). Observed heterozygosity was less than the expected heterozygosity indicating non-random mating in the population. F_{IS} value reinforced that the population is not in Hardy-Weinberg equilibrium as it ranged from -0.349 to 0.701 with a mean of 0.181 ± 0.059 (Table-10). Heterozygote deficiency of 18.1% along with the allele and gene diversity suggested existence of moderate genetic variation along with heterozygote deficiency in the Marwari camel population. The findings indicated towards the need of scientific management and undertaking conservation programs for Marwari camel.

Table 10: Genetic Diversity estimates of Marwari camel population

Locus	N	Na	Ne	I	Ho	He	F
LCA63	48	8	4.331	1.633	0.750	0.769	0.025
LCA77	48	7	2.653	1.168	0.271	0.623	0.565
VOLP08	48	3	1.596	0.621	0.438	0.373	-0.171
VOLP32	48	10	2.909	1.495	0.708	0.656	-0.079
YWLL44	47	6	2.314	1.154	0.574	0.568	-0.012
CMS13	45	9	5.025	1.852	0.400	0.801	0.501
CVRL04	43	10	4.796	1.788	0.698	0.792	0.119
CVRL05	44	12	6.757	2.087	0.591	0.852	0.306
LCA66	43	7	4.290	1.586	0.395	0.767	0.484
VOLP67	48	24	8.486	2.601	0.708	0.882	0.197
CMS50	47	10	5.516	1.919	0.915	0.819	-0.118
CVRL01	46	16	7.222	2.228	0.804	0.862	0.066
CVRL08	45	5	2.081	0.917	0.156	0.520	0.701
LCA90	46	5	2.689	1.102	0.696	0.628	-0.108
YWLL08	45	13	6.164	2.056	0.844	0.838	-0.008
CMS58	48	10	3.534	1.604	0.667	0.717	0.070
CVRL06	43	6	2.856	1.337	0.302	0.650	0.535
CVRL07	47	11	3.735	1.671	0.468	0.732	0.361
VOLP03	48	6	2.052	1.004	0.542	0.513	-0.057
YWLL09	46	4	1.617	0.688	0.130	0.382	0.658
CMS16	48	6	1.875	0.914	0.188	0.467	0.598
LCA18	43	5	3.522	1.351	0.628	0.716	0.123
LCA37	48	8	2.727	1.357	0.854	0.633	-0.349
VOLP10	47	12	4.240	1.773	0.660	0.764	0.137
YWLL38	47	9	3.537	1.557	0.723	0.717	-0.009
Mean	46.240	8.880	3.861	1.499	0.564	0.682	0.181
SE	0.371	0.886	0.368	0.098	0.045	0.029	0.059

N, Number of animals; Na, Number of observed alleles; Ne, Number of effective alleles; I, Shannon information index for polymorphism content; Ho, Observed heterozygosity; He, Expected heterozygosity; F, Heterozygote deficiency/inbreeding coefficient

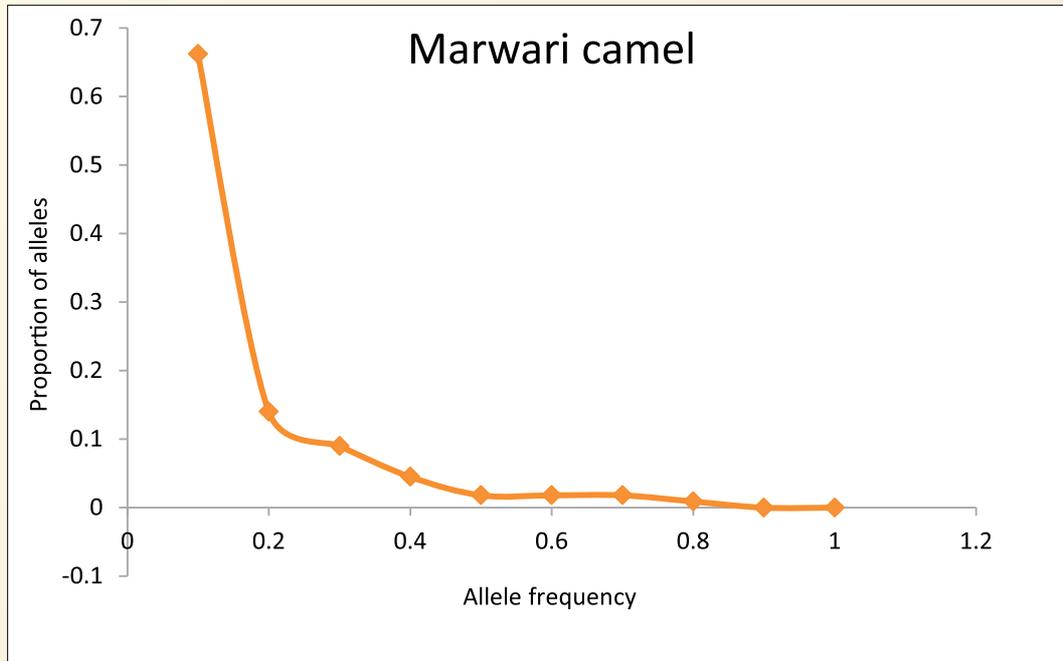


Figure 3: Graphic representation of proportion of alleles and their distribution

Bottleneck Analysis

Bottleneck influences the distribution of genetic variation within and among populations. In recently bottlenecked populations, the majority of loci will exhibit an excess of heterozygotes, exceeding the heterozygosity expected in a population at mutation drift equilibrium. To estimate the excess of such heterozygosity Sign, Standardized Differences and Wilcoxon Sign Rank Tests were utilized. The three models; Infinite Allele Model (IAM), Stepwise Mutation Model (SMM) and two-Phase Model of Mutation (TPM) were applied for detecting recent bottlenecks. Non-significant heterozygote excess on the basis of different models, suggested that there was no recent bottleneck in the existing Marwari population. The Mode-Shift Indicator test was also utilized as a method to detect potential bottleneck. A graphical representation utilizing allelic class and proportion of alleles showed a normal 'L' shaped distribution (Fig. 3). The L shaped curve indicated the abundance of low frequency (<0.10) alleles. This finding suggested the absence of any detectably large, recent genetic bottleneck (last 40-80 generations) in this population.

MANAGEMENT SYSTEM

Housing and Grazing Management

Camels are mostly reared under extensive management. No housing is provided during day as well as night time except to those which are reared for transportation, tourism or entertainment. The camels are kept in open and some time shelter is provided during night time. Some of the farmers makes temporary housing arrangement in the village outskirts or fallow land close to their household. These farmers moves within a limited area around their habitation for the grazing purposes and return back to village in the evening with their tolas. Some camel owners identify a place for temporary living for a period of about 4-5 days or longer depending on the availability of vegetation in the area. This place is generally referred as Dera in local dialect. This place can be any barren land or an agriculture field after harvesting of the crop. From these deras, they run their life during the period of stay. The animals move out from here for grazing and return in the evening. The average daily grazing distances is around 5-7 km and grazing hours are around 8-10 hrs depending on the season and fodder resources available in the tract. However, the migratory camels travel longer distances and hence the average grazing distance is around 11 km per day. The calves stay at the deras.

The camel owners tie one bell in the neck of a leader camel, generally the adult male camel, which helps the camel owners in locating the camels during grazing. The foot marks and fallen camel dung is also utilized for tracking the camels during grazing and migration. The body marks are also used to keep track of the location of the migratory and grazing stock.



Milking Management

The young calves are allowed to suckle their dams immediately when they return in the evening. Depending on the need, the camel owners milk the she-camels in the evening. The evening milk is generally consumed by the camel owners and their families and is not sold in the market. In the late evening, the camel owners tie the legs of their camels in sitting position so as to restrain them for the night time as well as to prevent the calves from sucking their dams. Some farmer keep the calves in separate enclosures to prevent suckling. Some farmers use locally made udder covers to prevent access of udder and teats to calves, thus disallowing further suckling. In the early morning, the camel owners milk the she-camels and the collected milk is sold in the markets either by the camel owners themselves or by their relatives.

Feeding Management

The animals are solely dependent upon grazing. An adult camel requires about 10-12 kg of dry fodder per day for maintaining its body weight and performing normal physiological functions. Apart from the camels which are maintained for tourism, cart pulling and entertainment, the camels are not stall fed or supplemented with some dry fodder in the breeding tract of Marwari camel. However, the calves and animals requiring special attention are fed at the place of temporary stay i.e. Dera. The camels graze mainly on the trees, herbs, shrubs available in the breeding tract. They are fed on the tree and the tree loppings offered by the accompanying grazer.

Neem (*Azadirachta indica*), Khejri (*Prosopis cineraria*), Babool (*Acacia arabica*), are common tree fodder available in the breeding tract. Dhokda (*Anogeissum pendula*), Rohida (*Tecomella undulata*), Kaldo, Kumta, Kumatia (*Acacia senegal*), Urajio (*Acacia leucophloea*), Israeli babool (*Acacia tortilis*), Mango (*Mangifera indica*), Peepal (*Ficus religiosa*), Kasod (*Cassia siamea*) are other tree species available on which camel feed. Phog (*Colligonum pologonoides*), Jal (*Salvadora oleiodes*), Kair (*Capparis decidua*), Bui (*Aerva javanica*), Sinio (*Crotolaria bhuria*), Ber (*Zizphus mauratiana*) are the common bushes found in the tract and utilized by the camels. The crop residues e.g. fodder of locally grown cereals like Wheat straw (*Triticum aestivum*), Cadvi of Jowar (*Sorghum vulgare*), Bajra (*Pennisetum typhoideum*), leguminous crops like Guar Phalgati (*Cyamopsis tetragonoloba*), Moth chara (*Phaseolus aconitifolius*), Groundnut fodder (*Arachis hypogaea*), Chana Chara (*Khariya*) (*Cicer arietinum*) etc. are generally available in the harvested agricultural fields and are also fed to the camels. Bhurat (*Cenchrus biflorus*), Doob (*Cynodon dactylon*), Bekaria (*Indigofera spp.*), Siyan (*Heteropogon contortus*), Dhaman (*Cenchrus ciliaris*) are the common grasses. The camel may feed on them but generally they are not available to camel because the other livestock species like cattle, sheep, goat etc. feed on them.

FEED AND FODDER RESOURCES



Camel Genetic Resources of India

A good number of camel owners provide salt to their camels. The quantity and frequency of offering sweet oil (Groundnut, Mustard, sesame and linseed) and concentrate feed depends on the know-how, economic status of the farmer, physiological state of the individual animal and economic returns expected out of it. The feeding of sweet oil and jaggery to breeding males is practiced by farmers to maintain the energy level during the breeding season.

Sufficient amount of water is available in the area. In Barmer and Jodhpur more than 80% farmers reported availability of drinking water and quantity of water available was also sufficient. However, in the Pali area only 45% farmer reported availability of water in sufficient quantity. Haud, kheli, tanka, pond, nadi, tubewells are the sources of drinking water for camel. Luni is the major river of the area.



Breeding and Reproductive Management

In Marwari she camels signs of estrus are generally seen at 3.50 years of age, successful mating takes place at an age of about 4.25 years and the first calving takes place at 5 years of age. Accordingly the number of calving in life time goes up to 8-9. The gestation period is 13 months and the inter-calving period is about 2 years. The females do not exhibit the signs of oestrus and are induced ovulator. However, a receptive female is considered in estrus. The Marwari male camels show puberty at an age of about 4-5 years. In male camels vocalization, lack of appetite, frequent micturition and restlessness can be seen during this period. They make lot of noise by taking out their inflated soft palate out of the mouth. The mating takes place, when the female camel is in sitting position.

The camel owners generally maintain one breeding male per herd, which may have about 15-20 breedable females. They do share the males with fellow farmers for breeding. Generally, 1-2 males of 1-3 years of age are kept in the herd as a replacer of the main breeding stud. However, the camel owners use their own wisdom and purchase adult male camel from other herds or from camel fairs for breeding purposes, as per the need. The farmer also use breeding males of other farmer on exchange basis. Breeding males are selected on the basis of physical feature, dam's yield, breed purity, production capacity and pedigree. Physical feature was the main criteria for selection of male, followed by dam's milk yield, breed purity and pedigree. More than 76% farmer considered more than one trait for selection of the males. A good male should have small mouth, small erect and alert ears, wide chest, narrow back and ancestry of female line of good milking ability.

Health Management

Mange is the most common disease and cause of concern to the camel breeders across the breeding tract of Marwari camel. It is caused by sarcoptic mite *Sarcoptes scabiei var. cameli*. Mange spreads by contact with infected animals or soil or surrounding. Improper management, malnutrition and overcrowding are generally the predisposing factors. Many a times fungal infection was also associated with it. Ivermectin injections along with antifungal treatment and external spray of Deltamethrin were found effective in curing the animals from this ailment.

Trypanosomiasis, is the another cause of worry to the camel breeder across the breeding tract. It is popularly known as Surra or Tibarsa because the disease causes progressive weakness and lasts for about 3 years. It is caused by a blood protozoa *Trypanosoma evansi*. Almost every camel owner goes for prophylactic as well as curative treatment of this disease. A number of chemo-therapeutic agent are available in the market but the combination of Quinapyramine sulphate and Quinapyramine chloride is among the safest drug.

Different kind of wound is also seen in the camels. Pneumonia, Camel pox, Mumadi, Foot rot, Pica, Mastitis are also seen in camels but the incidence is relatively very low compared to Mange and Trypanosomiasis. The progressive camel farmers do prophylactic medication with Fenbendazole or Albendazole for management of helminths. However, when clinical signs are observed, the camel owners undertake treatment. For contagious ecthyma in young animals the symptomatic treatment generally cures the animals. Apart from the above infectious and systemic diseases, the still Birth, abortion, dystocia and retention of placenta have been also reported as minor health issues by the camel owners in the breeding tract.



Migration of Marwari Camel

The camel farmers rely on the common property resources, forest, wastelands and harvested fallow fields for feed and fodder resources. As a result of which camels generally move in the range of about 40-60 km through out the year. The average grazing distance is about 11 km and the average grazing hours are 8-10 hr day. Apart from moving within the native districts, the camels of Pali district moves to Chittorgarh, Bhilwara, Kota, Jhalawar area of Rajasthan. They also migrate to Agar Malwa, Susner, Indore, Ujjain and Dewas area of Madhya Pradesh. During the rainy months of July to September migratory farmers stay in Rajasthan only. But during the winter and summer period they move to Madhya Pradesh area. During migration sheep can be seen accompanying the camel herds. Mostly, the camel owners of nearby locality put their camels in one herd during migration, so that the management becomes easier and the manpower can be utilized efficiently. The feed and fodder support and medicines for the sheep is provided by the state government in the migration routes falling under Rajasthan. The theft of the sheep, absence of healthcare support for camel, lack of sale of camel and dwindling grazing area are problems faced by the migratory camel farmers.



PRODUCTION OF MARWARI CAMEL

Milk Production

The future of the camel breeds holds on their milk production potential. Nineteen she-camels were recorded for a period of 13 months in the field area for their milk production potential (Table-11). Out of 19 females, 13 females milk yield were recorded once in a day (morning) and 6 female were recorded twice in a day (morning and evening both). Weekly/fortnightly milk recording of milk yield was carried out at the farmers door step. No special feed was given by the farmer's. Health was monitored throughout the lactation and milk production of only healthy animals were recorded. Normally animals are milked once. As per the practice adopted in the breeding tract, the farmers allow the calves to suckle in the evening and then separate the calves in enclosures to prevent suckling. Some farmers use locally made udder covers to prevent access of udder and teats to calves, thus disallowing further suckling. In the morning, they milk the animals and after that they allow the calves to be with mother for few hours and then separate the calves and take the dams for grazing.

However, to know the actual milk production, some of the animals were milked twice both in the morning and evening. The calves were separated from mother in night and in the morning milk yield was recorded. After morning milking calves were again separated from mother till evening recording. For milk let down suckling response of calf was essential.

Average morning milk yield was 3.00 ± 0.04 liters and evening milk yield was 2.45 ± 0.05 liters (Table-11). The average daily milk yield recorded for Marwari camels was 5.11 ± 0.10 liters (Table-12). After first month milk yield has increasing trend till 6th month of lactation (5.94 ± 0.34 liters). Wide variation in individual daily milk yield was observed. It ranged from (2.20 to 8.50 liters). The selection of elite milch animals for breeding and proper feed supplementation can further increase the milk production which can supplement the income of camel farmers in the breeding tract. The camel milk in the breeding tract is mostly used for self consumption and sold for human use by some of the farmers. It is generally consumed raw or used for the preparation of tea by farmers. The preparation and sale of products made from camel milk may further add to the income of the farmers. ICAR-National Research Centre on Camel, Bikaner has successfully prepared a variety of product from the camel milk.

Milk Composition

The analysis of milk composition was also carried out (Table-13) and the concentration of Fat, SNF (Solid Not Fat), Protein, and Lactose was recorded as 2.68%, 6.96%, 2.85%, and 4.31% respectively.

Table 11: Average morning and evening milk yield (L) of Marwari camels

Month of lactation	N	Morning	Range	N	Evening	Range
1	19	2.50±0.18	(1.50-4.00)	19	2.55±0.24	(1.20-4.20)
2	21	2.89±0.17	(1.80-4.20)	17	2.60±0.16	(1.70-4.00)
3	19	3.12±0.17	(2.00-4.25)	16	2.82±0.18	(2.00-4.00)
4	19	3.25±0.19	(2.00-4.50)	15	2.74±0.18	(1.80-4.00)
5	21	3.13±0.15	(2.00-4.25)	19	2.72±0.15	(1.80-4.00)
6	22	3.20±0.16	(2.00-4.30)	20	2.82±0.17	(1.80-4.10)
7	18	3.02±0.13	(2.30-4.00)	16	2.64±0.13	(2.00-3.70)
8	22	2.87±0.12	(2.00-3.70)	19	2.54±0.12	(1.80-3.40)
9	22	2.71±0.12	(1.70-4.50)	18	2.30±0.10	(1.50-3.10)
10	32	2.82±0.17	(1.30-5.00)	16	2.06±0.13	(1.00-3.00)
11	44	3.07±0.16	(1.50-5.00)	16	1.87±0.11	(1.20-2.90)
12	39	3.19±0.17	(1.50-5.50)	7	1.57±0.13	(1.30-2.30)
13	39	3.01±0.17	(1.20-5.00)	6	1.18±0.09	(1.00-1.30)
Overall	337	3.00±0.04	(1.20-5.50)	204	2.45±0.05	(1.00-4.20)

N = Number of milk yield records



Table 12: Average daily milk yield (L) of Marwari camel

Month of Lactation	N	Total	Range
1	19	4.95±0.43	(2.70-7.80)
2	17	5.34±0.34	(3.70-8.20)
3	16	5.83±0.37	(4.30-8.20)
4	15	5.73±0.36	(3.80-8.50)
5	19	5.73±0.30	(3.80-8.20)
6	20	5.94±0.34	(3.80-8.40)
7	16	5.56±0.26	(4.30-7.60)
8	19	5.34±0.25	(3.80-7.10)
9	18	4.86±0.2	(3.20-6.50)
10	16	4.35±0.26	(2.30-6.20)
11	16	4.01±0.23	(2.70-6.10)
12	7	3.37±0.25	(2.80-4.80)
13	6	2.57±0.08	(2.20-2.80)
Total	203	5.11±0.10	(2.20-8.50)

N = Number of milk yield records

Table 13: Milk composition (%) of Marwari camel

Components	N	Mean	Minimum	Maximum
Fat	51	2.68±0.11	1.20	4.77
SNF	33	6.96±0.18	4.60	9.40
Protein	6	2.85±0.33	1.85	3.70
Lactose	6	4.31±0.48	2.73	5.50

N = Number of observations / records

Hair Production

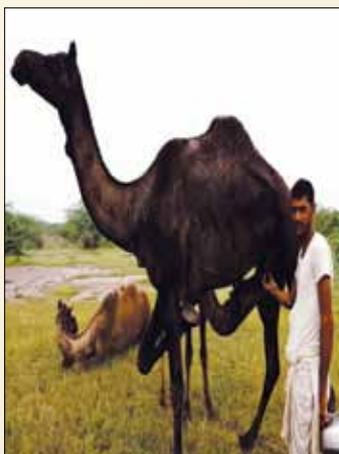
The camel hair is, being utilized in India since ancient times. The camel hair is used for making carpets, blankets, ropes and other daily use items. Fine quality hair is utilized for blanket making whereas coarse quality hair is used for carpet and rope making. These carpets and blankets are very cheap and durable. The rope made of camel hair is used for tying the animals and in making cots. Camel hair is harvested in the period coinciding with Holi festival. The animals are sheared using scissors or hair clippers. The annual hair production from an adult camel is about 500-700 gm. Patni and Dhillon, (1988) reported that it is worthwhile to blend camel hair with polyester, wool or silk waste. It has been estimated that a camel hair fabric of 620 g weight will be as warm as a pure wool fabric of 900 g weight (Khanna and Rai, 1991). The camel hair is stronger and warmer as compared to wool (Khanna and Rai, 1990). The handicraft articles made up of camel hair, provide work to women in the field of grading of hair, tops preparation, spinning of wool, weaving, embroidery with 100% speciality hair and blending with sheep wool, goat hair, cotton and other products. The average fiber length was 5.09 ± 0.21 cm, the average fiber diameter was $43.84 \pm 2.19 \mu$ and total medullation was $68.11 \pm 2.57\%$ (Table-14).

Table 14: Hair quality parameters of Marwari camel

Parameters	Male		Female		Over all	
	N	Mean±S E	N	Mean±S E	N	Mean±S E
Fibre Length (cm)	9	4.50±0.21 (3.10-7.30)	21	5.34±0.24 (3.60-7.50)	30	5.09±0.21 (3.10-7.50)
Diameter (μ)	13	45.98±2.63 (24.29-85.43)	37	37.74±3.50 (27.71-64.98)	50	43.84±2.19 (24.29-85.43)
Pure Fibre (%)	13	29.62±5.57 (1.00-62.00)	37	37.69±2.91 (3.33- 66.67)	50	31.89±2.57 (1.00-66.67)
Medullation: Hetero (%)	13	15.69±2.46 (1.67-31.33)	37	9.37±1.26 (0.33-32.67)	50	11.01±1.19 (0.33-32.67)
Medullation: Hairy (%)	13	54.31±6.68 (21.33-96.0)	37	57.97±3.48 (17.67 -94.33)	50	57.01±3.08 (17.67-96.00)
Total Medullation (%)	13	70.38±5.56 (38.00-99.00)	37	67.31±2.91 (33.33-96.67)	50	68.11±2.57 (33.33-99.00)

Figure in parenthesis are range values

MILK PRODUCTION IN MARWARI CAMEL



HAIR PRODUCTION IN MARWARI CAMEL



EFFORTS FOR CONSERVATION

Camel: Declared as the State Animal of Rajasthan

The camel became the first domesticated animal to be declared as “state animal” in India. The policy support related to ban on camel slaughter, new breeding policy with emphasis on camel milk, incentive for camel breeding, formation of breed registration societies and breeder association, etc. has been promulgated. The Rajasthan Camel (Prohibition of Slaughter and Regulation of Temporary Migration or Export) act, 2015” was enacted.

Camel Insurance

The Insurance scheme named “Bhamashah Pashu BimaYojana” for the livestock species including camel at subsidized rate has been launched by the Govt. of Rajasthan. Under the scheme camel owner can get maximum of five camels with a maximum cost of Rs. 50000/- per camel insured at a subsidized rate of 3.5 % for a period of one year or 9 % for a period of 3 years. This premium is further reduced by 70% in case of Scheduled Caste (SC), Scheduled Tribe (ST) and Below Poverty line (BPL) category, and by 50 % for general category.

Calf-Subsidy

A calf subsidy scheme was started by Govt. of Rajasthan to encourage the camel breeders to breed their camels at regular interval and to have a check on the declining population of the species. Under this scheme, a camel owner on registering his pregnant female camels was given cash incentive of Rs. 10000/- in three installments. First installment of Rs. 3000/- was given when the calf was born and attained an age of 1 month. The second installment of Rs. 3000/- was given when the calf attained an age of 9 month and the third installment of Rs. 4000/- was given when the calf attained the age of 18 months. Farmers have to insure these animals and when they sold these animals, they have to inform to the nearest veterinary hospital. The treatment of these animals were done free of cost.

FSSAI Approval

The Food Safety and Standards Authority of India (FSSAI) had set the all India standards for camel milk (Raw, pasteurized, boiled, flavored and sterilized) a minimum of 2.0 % Fat and 6.0% SNF from 1st June 2017.

Talks of Camel: Untan Ri Bataan

An All India Radio Programme “Untan Ri Bataan” (Talks of Camel) was broadcasted on every second and fourth Friday of the month in which twelve episodes were broadcasted between November, 2018 to April, 2019. The program was aimed at popularising camel milk. Hence, different subject matters like improving the milk productivity of the camels, product development from camel milk, camel milk marketing etc. were covered in different episodes. The program was broadcasted in Pali, Sirohi, Jodhpur, Jaisalmer, Barmer and Bikaner districts. For camel farmers who doesn't listen to the radio or have access to radio, group listening of the radio talk with the camel owners on the every second and fourth Friday of the month was also organized.

Meeting and Health camps

Meetings were also organized wherein apart from the deliberation on a particular topic, discussion on policy issues, question and answer sessions and on site treatment of sick animals was done. Sick camels were treated for various ailments during these health camps and meetings.

Way Forward for Improvement and Conservation

The utility of the species conserves it. The major source of income to the camel farmers in the Pali and Sirohi area is through sale of camel milk and surplus animals. The Open Nucleus Breeding Programme for increasing the milk production with its nucleus at the government farm or research centre and associated herds with camel owners may lead to significant improvement in the production potential of the animals and increase in their income. In the other parts of the breeding tract the milk production and sale activities may be encouraged. The camel riding, camel dancing, camel hair art, camel carts, camel safari and other aspect of camel draught utility present in the breeding tract should be further improved. These activities need to be supported and encouraged by promoting ecotourism in the area. The breeder's societies and Farmer Producer Organization should be set up in the breeding tract. Institutional support to camel farmers for undertaking ecotourism activities should be provided. The camel festivals should be organized at regular intervals with incentive to the farmers for production, decoration, hair design, dancing skills etc. The entrepreneurship in camel products processing and development, camel handicraft and camel ecotourism can attract the rural youth in camel rearing and

management. An integrated rotational grazing system, silvi pasture development programme along with proper nutritional and health care support will not only help the camel owners in maintaining the Marwari camel along with diverse livestock species under optimum production but will also boost their morale and bring economic prosperity to them.



MARWARI BREED DESCRIPTOR

A.	GENERAL DESCRIPTION	
1.	Name of the Breed	Marwari
2.	Local Names/synonyms	Marwari
3.	Species	Camel (<i>Camelus dromedarius</i>)
4.	Background for such name	Named after the habitat : Marwar
5.	Since when breed is known	Since long
6.	Communities responsible for breeding	Dewasi/Raika
7.	Native environment	
	a. Soil Description	Sandy clay, Sandy loam, saline
	b. Mean min. temperature (Summer)	22° C (Jodhpur) to 28° C (Barmer)
	c. Mean max. temperature (Summer)	41° C (Jodhpur) to 42° C (Pali)
	d. Mean min. temperature (Winter)	9° C (Pali) to 10° C (Jodhpur)
	e. Mean max. temperature (Winter)	28° C (Barmer) to 36° C (Jodhpur)
	f. Mean relative humidity	25-55%
	g. Annual rainfall	243 mm (Barmer) to 462 mm (Pali)
8.	Feed and Fodder	
	a. Dry feeds	Wheat straw (<i>Triticum aestivum</i>), Cadwi of Jowar (<i>Sorghum vulgare</i>), Bajra (<i>Pennisetum typhoideum</i>), Guar Phalgati (<i>Cyamopsis tetragonoloba</i>), Moth chara (<i>Phaseolus aconitifolius</i>), Groundnut fodder (<i>Arachis hypogea</i>), Chana chara (<i>Khariya</i>) (<i>Cicer arietinum</i>) etc
	b. Green fodder	Bajra (<i>Pennisetum typhoideum</i>), Jowar (<i>Sorghum Vulgare</i>) and Jai (<i>Avena fatua</i>).
	c. Grasses	Bhurat (<i>Cenchrus biflorus</i>), Doob (<i>Cynodon dactylon</i>), Bekaria (<i>Indigofera spp.</i>), Siyan (<i>Heteropogon contortus</i>) Dhaman (<i>Cenchrus ciliaris</i>)

	d. Bushes	Phog (<i>Calligonum polygonoides</i>), Jal (<i>Salvadora oleiodes</i>), Kair (<i>Capparis decidua</i>), Bui (<i>Aerva tomentosa</i>), Sinio (<i>Crotolaria bhuria</i>), Ber (<i>Zizphus mauritiana</i>)
	e. Trees	Neem (<i>Azadirachta indica</i>), Khejri (<i>Prosopis cineraria</i>), Babool (<i>Acacia Arabica</i>), Dhokda (<i>Anogeissus pendula</i>), Rohida (<i>Tecomella undulata</i>), Kaldo, Kumta, Kumatia (<i>Acacia senegal</i>), Urajio (<i>Acacia leucophloea</i>), Israeli babool (<i>Acacia tortilis</i>), Mango (<i>Mangifera indica</i>), Peepal (<i>Ficus religiosa</i>), Kasod (<i>Cassia siamea</i>)
	f. Other	Sweet oil (Groundnut, Mustard, Sesame, Linseed), Jaggery, turmeric, Ajwain and common salt
9.	Housing	
	a. Nights	Mostly temporary enclosures without overhead shed.
	b. Day	None
	c. Housed in Kuchha	Mostly
	d. Housed in pucca	None
	e. Open house	Mostly
	f. Closed type house	None
10.	Water sources	
	a. Haud (%)	6.79
	b. Kher (%)	15.43
	c. Kheli (%)	30.25
	d. Nadi (%)	5.55
	e. Ponds (%)	30.25
	f. Tanka (%)	6.79
	g. Tubewell/well (%)	4.94

Camel Genetic Resources of India

11.	Management	
	a. Semi-intensive (%)	Negligible
	b. Extensive (%)	Mostly
12.	Mating method	Natural service only (Breeding season: December to February)
B. PHYSICAL CHARACTERISTICS		
1.	Coat color	
	a. Light Brown (%)	3.00
	b. Sand Brown (%)	38.00
	c. Brown (%)	21.00
	d. Dark brown (%)	19.00
	e. Deep dark brown (wenge/blackish) (%)	19.00
3.	Hair length	
	a. Small (%)	25.00
	b. Medium (%)	60.00
	c. Large (%)	15.00
4.	Head	
	i. Size	
	a. Small (%)	38.00
	b. Medium (%)	44.00
	c. Large (%)	18.00
	ii. Fore head	
	a. Normal/Flat (%)	96.00
	b. Prominent (%)	4.00
	iii. Muzzle	Tight

	iv. Lips	
	a. Normal (%)	90.00
	b. Sharp (%)	10.00
5.	Body size	
	a. Small (%)	20.00
	b. Medium (%)	42.00
	c. Large (%)	38.00
6.	Chest pad	Developed
	Normal (%)	97.00
	Prominent (%)	3.00
7.	Hump size	
	a. Small (%)	21.00
	b. Medium (%)	56.00
	c. Large (%)	23.00
8.	Udder (Females)	
	a. Round (%)	55.00
	b. Pendulous (%)	45.00
9.	Milk vein (Females)	
	a. Small (%)	14.00
	b. Medium (%)	49.00
	c. Large (%)	37.00
10.	Temperament	
	a. Active (%)	81.00
	b. Dull (%)	19.00

Camel Genetic Resources of India

11.	Morphometric characters (cm)	Adult Male	Adult Female
	i. Heart girth	221.16±1.54	216.86±0.50
	ii. Body length	169.08±1.60	165.27±0.39
	iii. Height at wither	200.96±1.73	202.37±0.54
	iv. Tail length	59.32±0.74	57.02±0.21
	v. Neck length	118.62±1.06	119.93±0.38
	vi. Face length	46.33±0.61	45.72±0.21
	vii. Distance between eyes	23.94±0.26	23.79±0.08
	viii. Ear length	10.87±0.28	10.44±0.09
	ix. Fore leg length	148.04±0.82	147.68±0.22
	x. Hind leg length	166.11±1.11	162.78±0.28
	xi. Foot pad(L/W)		
	Fore leg (length)	21.66±0.21	21.39±0.06
	Fore leg (width)	20.94±0.18	21.01±0.06
	Hind leg (length)	20.48±0.20	20.44±0.07
	Hind leg (width)	19.87±0.26	20.11±0.09
12	Growth of Marwari camel (body weight in kg)		
	Age group	Female	Male
	i. Up to 1 year	195.76±10.14	233.78±8.58
	ii. 1-4 year	496.68±5.88	486.14±9.43
	iii. Adult	642.46±2.57	664.38±7.83

C. PERFORMANCE		
1.	Draught	Good
2.	Dairy Performance	
	a. Daily milk yield	5.11 liters per day (with calf suckling)
	b. Lactation length	13-16 months
3.	Hair Production (Annual)	500-700 gm per annum
4.	Hair Quality	
	a. Fibre length (cm)	5.09±0.21
	b. Fibre diameter (μ)	43.84±2.19
	c. Medullation (%)	68.11±2.57
D. REPRODUCTION		
	Female	
	Age at first oestrus	3.50 years
	Age at first mating	4.25 years
	Age at first calving	5.05 years
	Inter calving period	2.01 years
	Gestation period	13 months
	No. of calving	8-9 in life time
	Service period	1.01 years
	No of service per conception	1.40
	Male	
	Age at first ejaculation	4.22 years
	Age at first service	4.80 years

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