

**BREED CHARACTERISTICS AND MANAGERIAL
PRACTICES FOR KACHCHHI CAMEL**

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BY

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1996



D e d i c a t e d

T o

Traditional Camel Breeders

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57

A B S T R A C T

BREED CHARACTERISTICS AND MANAGERMENTAL PRACTICES FOR KACHCHHI CAMEL

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The present investigation was carried out to study the important breed characteristics of Kachchhi camels and traditional managerial practices followed by the camel breeders in Kachchh district of Gujarat State.

In all 326 Kachchhi camels of different age groups were covered to study physical characteristics and biometry. Status of performance and traditional managerial practices for the Kachchhi camels was surveyed through personal interviews of 74 traditional breeders in three talukas of Kachchh district.

The Kachchhi camels are light to medium in size with darkbrown, brown or reddish brown coat colour. These camels have small erect ears with tips turning in. They have small well set muzzles and lips.

On an average body length, height at withers and heart girth measured 81.17 ± 1.32 , 110.42 ± 1.35 and 76.92 ± 2.81 cm in male; and 61.46 ± 1.01 , 109.15 ± 1.13 and 72.77 ± 1.56 cm in female, respectively at birth. The corresponding body

measurements in adult were 159.82 ± 2.10 , 195.00 ± 3.55 and 195.93 ± 2.11 cm in male; and 156.15 ± 0.76 , 192.16 ± 0.77 and 204.75 ± 10.77 cm in female, respectively. The height at wither in adult camel was found to be a reliable measure for growth from its association with important body measurements.

Majority of the traditional camel breeders were following age at first mating of 3 to 4 years in female and 4 to 5 years in male camel. About 47 per cent of the breeders used one stud camel for 50 to 70 females. Winter was the common breeding season resulting into calving in late winter in the camels. The camel breeders generally relied on the stud camel for detecting females in oestrus. However, they were having confidence in detecting conception of 10 to 15 days from a behavioural sign, 'cocking of tail'.

Daily milk production of 5.52 ± 0.29 litres was recorded in the Kachchhi camels. The camel milk on an average contained 11.24 per cent total solids, 3.07 per cent fat, 2.85 per cent protein, 4.27 per cent lactose and 0.84 per cent ash. The milk from camel was used for family consumption. There was taboo on sale of camel milk.

Rabaries were the major traditional camel breeders responsible for development and preservation of Kachchhi breed as their ancestral profession. For about 51 per cent of the camel breeders, Animal Husbandry was the only source of income. Due to constant migration and remoteness of their villages, most of them remained illiterate.

The herd size of Kachchhi camels varied from less than 5 to 100 animals. Herds of 50 camels were commonly encountered in the district. Average herd size was of 40.74 ± 2.83 camels with 6.17 young males, 0.59 breedable male, 12.27 young females and 21.70 adult females. Without exception they were managed on extensive system of feeding on natural feed resources. On an average 11 to 12 hours of browsing time was provided. The camel breeders were having good knowledge and skill for browsing their camels on variety of trees, shrubs, creepers and other vegetation. The breeders maintained their camels on 'zero' input basis. Generally no supplementary feeding of any kind was done. Only the stud camels were given some energetic feed during breeding season.

Newborn calf was allowed to suckle colostrum freely. The growing calf was kept with herd and was having free access to suckle sufficient milk from the dam. Nose-pag was applied to the male camel at the age of 2 to 3 years. Sale of surplus male camel was the only source of income from the herd for the traditional breeders. The camel hair was used for preparing articles of daily use.

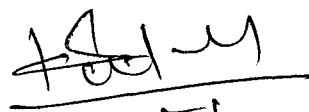
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C E R T I F I C A T E

This is to certify that the thesis entitled, "BREED CHARACTERISTICS AND MANAGERIAL PRACTICES FOR KACHCHHI CAMEL" submitted by Mukesh Karsandas Patel in partial fulfilments of the requirements for the degree of Master of Veterinary Science in Livestock Production of the Gujarat Agricultural University is a record of bonafide research work carried out by him under my guidance and supervision, and thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

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C O N T E N T S

CHAPTER	TITLE	PAGE
I	INTRODUCTION	1
II	REVIEW OF LITERATURE	6
III	MATERIALS AND METHODS	87
IV	RESULTS AND DISCUSSION	97
V	SUMMARY AND CONCLUSIONS	154
	REFERENCES	i to viii.
	APPENDIX	I to VI

LIST OF TABLES

Table	Title	Page No.
2.1.1	Camel population trends in the world and India (Thousands)	10
2.1.2	Countrywise population of camels (Thousand)	11
2.1.3	Statewise and yearwise camel population in India (Thousands)	12
2.3.1	Birth weights in native and crossbred camels (kg)	19
2.3.2	Body weights in different age groups of native and crossbred camels (kg)	22
2.4.1	Length of important body parts in native and crossbred camels (cm)	27
2.4.2	Height of important body parts in native and crossbred camels (cm)	32
2.4.3	Circumference of important body parts in native and crossbred camels (cm)	35
2.5.1	Breeding performance of native camel breeds	43
2.6.1	Milk yield of camels	54
2.6.2	Gross composition of camel milk	57
2.7.1	Annual hair production (kg per head)	59
2.8.1	Size distribution of 'Raika' camel herds	64
2.8.2	Composition of grasses from the saline region of Banni area in Kachchh	69
2.8.3	Daily nutrient requirement for maintenance of camels	70
2.8.4	Daily nutrient requirement of growing camels (growth rate 100 g/day)	71
2.8.5	Classification of different species of grazing animals by some characteristics of feed and water intake	75
4.1.1	Frequency and percentage distribution of body coat colour in different age groups	99

contd...

Table	Title	Page No.
4.2.1	Length of important body parts in different age groups of Kachchhi camels	101
4.2.2	Height of important body parts in different age groups of Kachchhi camels	106
4.2.3	Circumferences of important body parts in different age groups of Kachchhi camels	111
4.2.4	Coefficients of correlations between various body measurements at birth and adult age	114
4.3.1	Estimated adult body weight of Kachchhi camel (kg)	116
4.4.1	Average age at first service in she-camels	117
4.4.2	Average age at first breeding in male camels	119
4.4.3	Ratio of male to females in Kachchhi camels	120
4.4.4	Monthwise distribution of calving in Kachchhi camels	122
4.4.5	Cocking of tail as the earliest sign of pregnancy observed by camel breeders	124
4.4.6	External signs of approaching parturition in Kachchhi camels	127
4.5.1	Daily milk yield of Kachchhi camels obtained by traditional breeders	128
4.5.2	Gross chemical composition (%) of milk from Kachchhi camel	130
4.8.1	Social groups of traditional Kachchhi camel breeders	133
4.8.2	Family size of Kachchhi camel breeders	134
4.8.3	Classification of camel breeders as per their occupation	135
4.8.4	Landholding by the Kachchhi camel breeders	136
4.8.5	Camel herd size maintained by the traditional breeders	138
4.8.6	Kachchhi camel herd structure	139

contd...

Table	Title	Page No.
4.8.7	Extent of migration by Kachchhi camel herds	140
4.8.8	Duration of browsing practiced by Kachchhi camel breeders	143

LIST OF FIGURES

Figure No.	Title	Page No.
2.1	Map of camel habitats	8a
2.2	Distribution of the one-humped camel and areas of attempted introduction (dots)	8b
2.3	Plan of a camel shed for ten camels	87a
2.4	Plan of stables for housing twelve camels	87b
3.1	A map of Gujarat showing placement of Kachchh and adjoining districts	87a
3.2	A map showing details of talukas of Kachchh district	87b
3.3	Illustration showing the details of the body measurements	90a
4.1	Distribution of coat colour in Kachchhi camel	99a
4.2	Body length of Kachchhi camel	104a
4.3	Height at withers of Kachchhi camel	106a
4.4	Heart girth of Kachchhi camel	111a
4.5	Monthwise distribution of calving in Kachchhi camel	122a
4.6	Chemical composition of milk from Kachchhi camel	130a
4.7	Land holdings by Kachchhi camel breeders	136a

LIST OF PLATES

Plate	Title	Page No.
I	Photograph showing a general outlook of a Kachchhi she-camel with dark brown colour	99b
II	Photograph showing brown coat, light body and handsome look of a Kachchhi camel. Please note typical ears of the camel.	99b
III	A Kachchhi camel with black body coat	99c
IV	A Kachchhi she-camel having brownish white coloured coat with brownish calf at foot	100a
V	Capacious udder and moderate size of teat in a Kachchhi camel	100a
VI	Closer view of head of a male Kachchhi camel	120a
VII	A typical rutting male camel	120a
VIII	Courtship in Kachchhi camels before mating	123a
IX	Mating in Kachchhi camels	123a
X	A pregnant she-camel	124a
XI	Engorgement of udder and teats before parturition	126a
XII	Milking of camel in standing position	129a
XIII	Articles prepared from camel hair and its blend	131a
XIV	Metaphase spread from male Kachchhi camel (Giemsa stained X1000)	132a
XV	Metaphase spread from female Kachchhi camel (Giemsa stained X1000)	132a
XVI	Karyotype prepared from male Kachchhi camel (Giemsa stained X1000)	132b
XVII	Karyotype prepared from female Kachchhi camel (Giemsa stained X1000)	132c
XVIII	A Kachchhi camel herd resting during mid day	142a
XIX	Camel prefer to browse rather than to graze	142a
XX	A Kachchhi camel herd enjoying browsing	142b
XXI	Over browsing of trees should be avoided	142b

Plate	Title	Page No.
XXII	A tree species <i>Acacia senegal</i> is commonly preferred top feed	146a
XXIII	Gundi (<i>Cordia gharaf</i>) as a top feed for camel	146a
XXIV	Khejri is known as a Kalpavruksh of deserts	146b
XXV	<i>Prosopis juliflora</i> is widely spread in Kachchh	146b
XXVI	Luno is of preferences while grazing	146c
XXVII	<i>Fagonia cretica</i> from grazing land of Rapar taluka	146c
XXVIII	<i>Cressa cretica</i> a common plant available during summer in Banni grass land	146d
XXXIX	<i>Grewia</i> species a common pasture plant available in Kachchh	146d
XXX	<i>Leptadenia reticulata</i> is a common creeper of Lakhapat taluka.	146e
XXXI	Creeper of <i>Grewia</i> species	146e
XXXII	<i>Asparagus racemosus</i> is a common creeper climbing trees in Kachchh	146f
XXXIII	Ponds are common sources of drinking water for camels	148a
XXXIV	Community water troughs are built by villagers for clean-fresh water	148a
XXXV	A newly born calf suckling colostrum from dam	149a
XXXVI	A grown calf is allowed to suckle dam at limited times. Note the netting taken aside while suckling	149a

LIST OF ABBREVIATIONS

a.m.	:	ante meridiem
Ca	:	Calcium
c.f.	:	Cited from
cm	:	Centimetre
Contd.	:	Continued
CP	:	Crude protein
DCP	:	Digestible crude protein
DM	:	Dry matter
EE	:	Ether extract
<i>et al.</i>	:	And others
Fig.	:	Figure
g	:	Gram
ICAR	:	Indian Council of Agricultural Research
ISI	:	Indian Standard Institute
kg	:	Kilogram
L	:	Litre
ml	:	Millilitre
NFE	:	Nitrogen free extract
No.	:	Number
NRCC	:	National Research Centre on Camel
%	:	Per cent
P	:	Phosphorus
p.m.	:	Post meridiem
RPMI 1680	:	Rosewell Park Memorial Institute 1680
Rs.	:	Rupees
SNF	:	Solids not fat
TDN	:	Total digestible nutrient
T.S.	:	Total solids
μ m	:	Micro molar
Viz.,	:	Namely
Yrs	:	Years

CHAPTER I

INTRODUCTION

Camel is an important species of domesticated animal adapted to the desert eco-system and dry land livestock production system. Camel is known as 'ship of desert' because of its distinctive ability to adapt adverse ecology of arid region and utilize restricted resources. It has a hump which serves as reservoir of energy during lean period. It has soft elastic food pads with thick skin around, which is good for long travel on sandy terrains. It can survive in the hot arid climate with higher solar radiation. It causes less destruction to the fragile vegetation of the dry land due to its different feeding and browsing behaviour than the other domesticated livestock. It can also survive without water for longer period than other livestock.

Camels have multipurpose utility for draft power, milk, hair, hide and meat. They are useful in transportation of man and material both on their back as well as through camel carts. They are important source of motive power in arid areas for various agricultural operations including lifting of water from wells. Even the sheep and goat breeders keep camel as a cargo carrier to carry their household possessions during migration. The importance of camels in boarder security is well-known. With the rise in fuel price, the camel carts are increasingly used for short distance transport in rural areas. The banks are financing for camel and camel cart, as transportation through camel cart is a viable business. The male camels are in high demand and are

providing principal source of income to the camel breeders from their sale. breeders.

Milk of camel is an important staple food for the traditional camel breeders. It is consumed raw as well as used in preparing tea or rice-pudding (*Khair*). Family milk requirement of the traditional breeders is met from camel milk. Many a time, camel milk is only food component for the traditional camel breeders during migration in arid areas. Camels are more efficient milk producer than cows and buffaloes on scanty and coarse vegetation of dry land. Though the camel milk has moderate nutritive value, it has certain medicinal utility (Rao *et al.*, 1970 and Khanna, 1990).

Camel hair is used for making clothes, carpets, rugs, ropes and household articles. Camel hide is utilized in making various leather articles. Meat of camel is consumed in Arabian countries. However, there is religious taboo on slaughter of camel and consumption of camel meat in India.

Two species of camels are found in the world. The bactrian or double hump camels are found in Northern colder zone and the dromedary or single humped camels are found in the Southern hotter zone. Bactrian camels are long haired, sturdy and powerful animals accustomed to rigorous climate. They are also capable of marching on snow covered mountains. The single humped camels have longer legs, lighter in builtup, short coat and are capable of working in hotter climate. The greatest number of dromedaries are found in Eastern Africa, Somalia, Sudan, Ethiopia and Kenya

covering two-third of the world dromedary population. The animals in this part are almost extensively in the possession of nomadic and semi-nomadic pastoralists (Schwartz, 1992).

There are supporting evidences from archaeology, literature, arts, numismatics as well as religious and social heritage, reflecting the presence and importance of camels in India since protohistoric period to the present times (Anonymous, 1990). Distribution of dromedary camels in India is presently confined to the dry lands of North-Western India.

At present there are 17.019 million camels in the world (FAO, 1993) which includes about 2 million bactrian camels. The distribution of dromedary extends over the semi-arid and arid tropical and subtropical regions of Asia and Africa. As per FAO (1993), camel population in India is 1.5 million accounting 8.8 per cent of the world camel population. Camels of India are mainly dromedary and very few are bactrian type; normally found in Ladakh area of Jammu and Kashmir.

In India, Rajasthan has the highest camel population (70%) followed by Haryana, Gujarat and Punjab. The camel population in Gujarat constituted 4.9 per cent of the Indian camel population in 1981, which increased to 7 per cent in 1982 (Khanna and Rai, 1991). At present camel population in Gujarat is estimated to be sixtytwo thousand (Anonymous, 1995), of which the Kachchh district has the highest number (28.31%) of camels in the state.

Camel production in arid and semi-arid regions of the country is largely under extensive system of feeding management. The animals are usually reared on top feeds and grasses from natural fallow and wasteland. Camel can eat foliage from variety of trees and shrubs including those which are thorny, salty or bitter. Camel production plays an important role in the economy of arid region where inherent risks are involved in crop farming due to low and uncertain rains and soil type.

In India and Pakistan, the camel production belongs to nomadic and seminomadic tribes or else is associated with marginal agriculture as working animals. The traditional camel breeders played crucial role in developing and preserving many camel breeds in India. The camel breeds so evolved are well adapted to the harsh agro-climate of dry lands and therefore camel husbandry is a prime vocation in the region.

Kachchhi is the prominent breed of North-Western India with its breeding tract limited to the Kachchh district of Gujarat. The male animals are taken for draft purpose in most of the districts in Gujarat. The population size of Kachchhi camels especially true to the breed is declining and deteriorating due to mechanization, decrease in pasture resources and fast changing social structure. It is therefore necessary to take suitable measures for conservation of this breed. This should be preceded by genetic evaluation and characterization for establishing norms of the breed. Such standard norms of the breed have not been defined well so far through scientific studies covering breed

characteristics, productive and reproductive performance, traditional feeding and management etc. in its home tract. Cytogenetic characters including model karyotype, relative length, centromic index etc. are yet to be studied. The present study was, therefore, aimed :

1. To study distinct breed characteristics including biometry of Kachchhi camels.
2. To study productive and reproductive performance of Kachchhi camels under traditional management in their home tract.
3. To study model chromosomal profile in the breed.
4. To survey status of traditional camel breeding, feeding, management and health care.
5. To study socio-economic status of the traditional Kachchhi camel breeders.

CHAPTER - II

REVIEW OF LITERATURE

The principal aim of the project executed is to study the breed characteristics and traditional management practices for Kachchhi camels in their home tract. The pertinent literature has been reviewed under following sub-heads :

- 2.1 Camel population and its distribution
 - 2.1.1 Origin and history of domestication
 - 2.1.2 Distribution
 - 2.1.3 Camel population trends
- 2.2 Distinct characteristics of indigenous camel breeds
- 2.3 Body weights
 - 2.3.1 Birth weight
 - 2.3.2 Body weights in different age groups
 - 2.3.3 Growth
- 2.4 Body measurements at different ages
 - 2.4.1 Length of body parts
 - 2.4.2 Height of body parts
 - 2.4.3 Circumference of body parts
 - 2.4.4 Relation between body weight and biometrical measurements
- 2.5 Reproduction in camel
 - 2.5.1 Sexual maturity and age at first service
 - 2.5.2 Breeding seasons
 - 2.5.3 Signs of oestrus
 - 2.5.4 Length and signs of pregnancy
 - 2.5.5 Age at first calving
 - 2.5.6 Calving interval
 - 2.5.7 External signs of approaching parturition

- 2.6 Milk production
 - 2.6.1 Milk yield
 - 2.6.2 Gross composition of milk
- 2.7 Camel hair and utility
- 2.8 Model chromosomal profile
- 2.9 Traditional camel management practices
 - 2.9.1 Traditional camel breeders
 - 2.9.2 Camel pastoralism
 - 2.9.3 Housing facilities
 - 2.9.4 Feeding and watering management
 - 2.9.5 Care and management of camels
 - 2.9.6 Camel health

2.1 CAMEL POPULATION AND ITS DISTRIBUTION

2.1.1 Origin and history of domestication

The word 'Camel' has derived from the Greek word *Kremal*. The Greeks borrowed this word from the original Sanskrit word, *Krelok* which means 'throw away legs'. This word might have been given to the camel in Sanskrit because when it runs, it actually throws out its legs in the air and has very little control over them (Mondal and Samanta, 1995).

According to the zoological classification, camel, llama, alpaca, guanaco and vicuna constitute one family, camelidae, which is supposed to be originated before 5 million years ago (3000 to 4000 B.C.) in North America. There is another school of thought stating the origin of Camelidae in Arabia and postulates migration of llama to South America via land route through North America (Mondal and Samanta, 1995).

The genus *Camelus* has two species viz., *Camelus bactrianus* (two humped camel) found in Africa, Arabian region and Afghanistan; and *Camelus dromedarius* (one humped camel) found in Central Asia and Western parts of China. The one-humped camel is taller and slimmer bearing a shorter hairy body coat. In contrast to this, the two-humped camel is shorter, stouter and has a thicker and a longer hairy coat (Mondal and Samanta, 1995).

Dorman (1984) while reviewing literature on domestication of camels, however, came to the general conclusion that probably the dromedaries were first domesticated in Arabian peninsular around 4000 B.C. and the Bactrian camels were domesticated in North-Eastern Iran and Soviet Turkmenistan around 2500 B.C.

2.1.2 Distribution

The genus *Camelus* is found in arid areas. The Bactrian camels are inhabiting in the northern cooler zone, whereas, the dromedary camels are inhabiting in the southern hotter zone, with an overlapping area in parts of Soviet Union where hybrids are also found (Fig.2.1). In Asia the dromedary is found in Saudi Arabia, Syria, Jordan, Lebanon (seasonally), Oman, Yemen Arab Republic, Yemen Democratic Republic, Israel, Iraq, United Arab Emirates, North West India, Pakistan, Turkey, Iran, Afghanistan, Western Sinkiang (China) and the south Western Soviet Union mainly Turkmenistan. The one humped camels (dromedary) were also taken to other countries, but now they are only found in Australia (almost all feral) and the Canary Islands (Dorman, 1984).

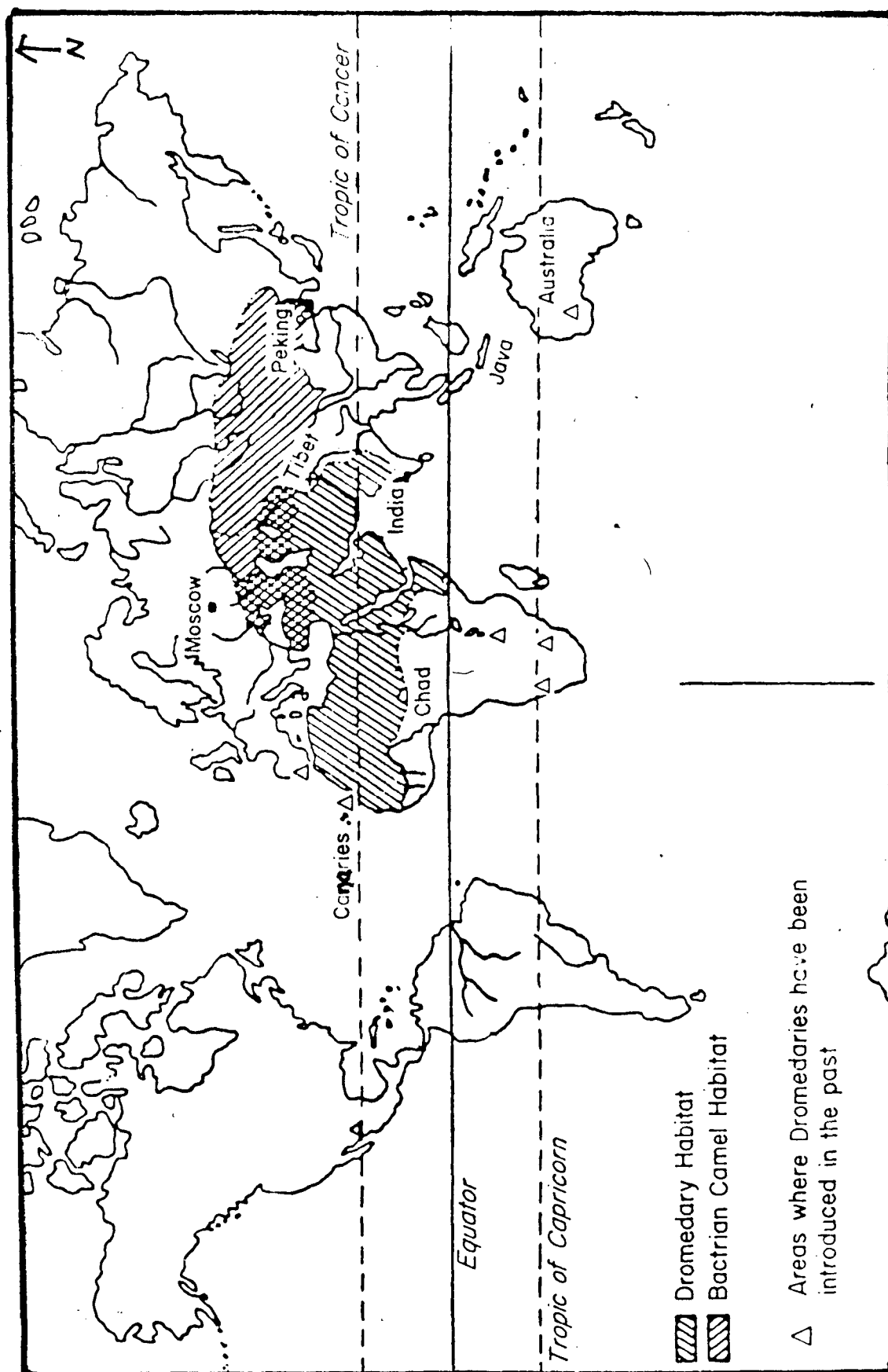


Figure 2.1: Map of camel habitats.

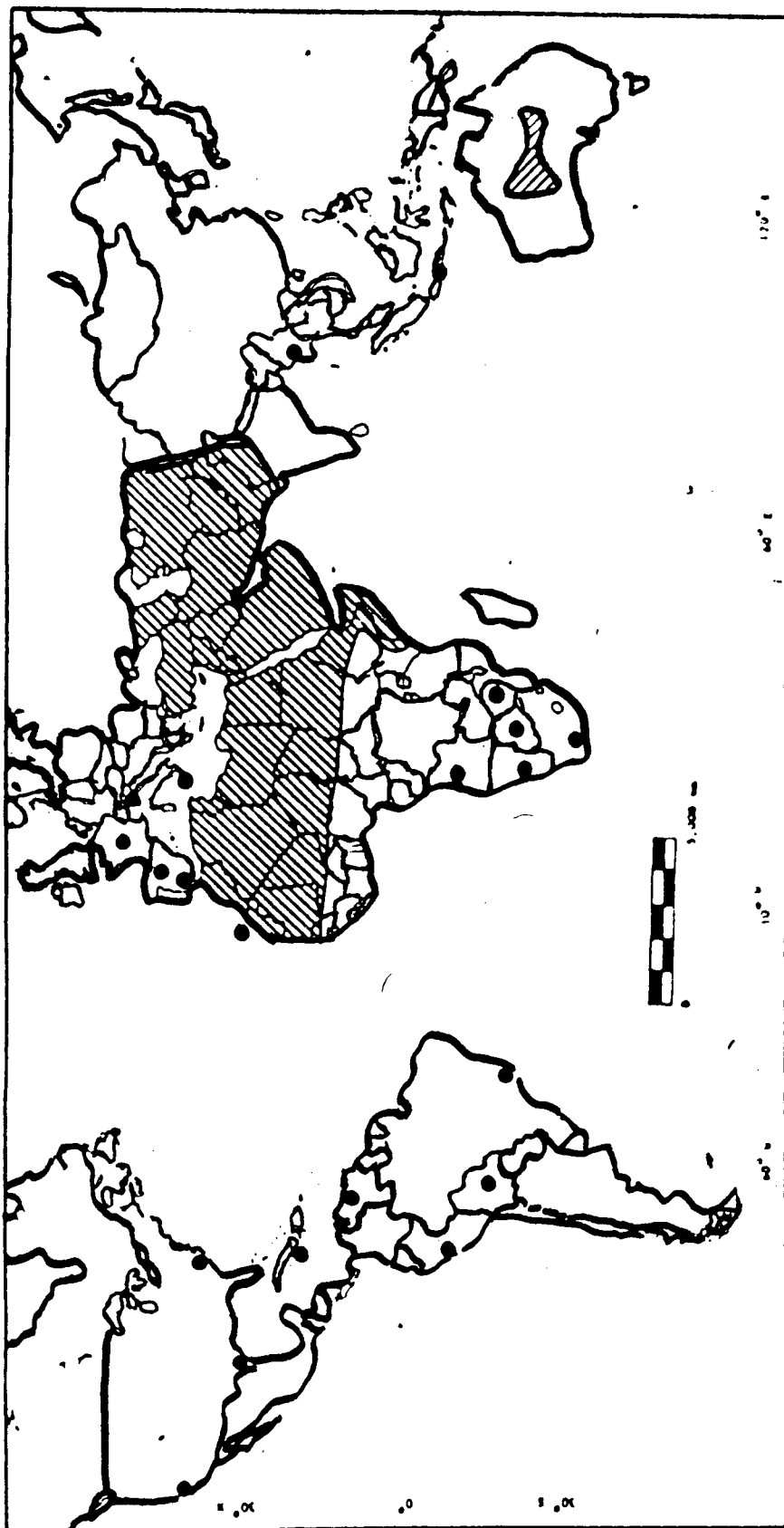


Figure 2.2: Distribution of the one-humped camel and areas of attempted introduction (dots).

The highest number of dromedaries are found today in Eastern Africa, Somalia, Sudan, Ethiopia and Kenya covering about two thirds of the world dromedary population. India and Pakistan possess two million dromedaries, and they belong to Sedentary pastoralist or else, in association with marginal agriculture, as working animals (Schwartz, 1982).

According to Kohler-Rollefson (1994) one humped camels are distributed from Mauretania in the west to India in the east. Feral camels live in central Australia, from where they are sometimes exported to the middle east. The camels are also exported to new areas namely South West Africa, the United States, Venezuela etc. which is depicted by dots in the Figure 2.2.

2.1.3 Camel population trends

The data on population trends of camel in the world (FAO, 1993) and India (Khanna *et al.*, 1990a) are presented in Table 2.1.1. The increase in camel population from 1945 to 1982 was about 70.58 per cent in the world and that was 129.35 per cent for India. The maximum growth rate of 39.45 per cent in world camel population was recorded between 1966 and 1972. The highest increase (23.37 per cent) in camel population in India was between the 1951 and 1961. The camel population in the world declined by 9.8 per cent between 1991 and 1982. However, the camel population in India showed an increase of 0.67 per cent during the same period.

The countrywise distribution of camel population (FAO, 1993) is presented in Table 2.1.2. Out of 17.019 million camel

Table 2.1.1 Camel population trends in the world and India (Thousands)

Year	Camel population		Indian population as % of world population	Rate of growth %	
	World	India		World : India	
1945	9,977	854	8.58	-	-
1951	10,408	829	8.04	4.33	3.81
1956	11,319	770	6.86	8.74	23.37
1961	11,319	903	7.98	-	16.37
1966	11,764	1028	8.74	3.93	13.84
1972	16,405	1109	6.76	39.45	7.88
1977	17,040	1068	6.27	3.87	-3.70
1982	16,530	1078	6.52	-3.00	0.94
1985	17,440	1100	6.30	5.51	2.04
1990 F	18,779	1450	7.72	7.67	3.50
1991 F	17,887	1490	7.89	-0.48	2.70
1992 F	17,019	1500	8.80	-9.80	0.67

F indicates FAO (1993) estimate.

population in the world 16.70 million (98.13 per cent) are available in the developing countries. India ranks third in the camel population (1.5 million) and is only next to Somalia and Sudan in the world, keeping first rank in the Asian countries.

Camels are confined largely to arid and semi-arid zones of India. Khanna *et al.* (1990^a) reported that camel population was

the highest in Rajasthan (70 per cent) followed by Haryana (11 per cent), Gujarat (7 per cent) and Punjab (5.9 per cent) states of India. The other states having 6 more than one thousand camels were Himachal Pradesh, Jammu and Kashmir, Manipur and Maharashtra.

Table 2.1.2 Countrywise population of camels (Thousands)

World	17,019		Asia	4893	
Africa	11,817		Afghanistan	265	F
Algeria	130	F	Bahrain	1	F
Burkinafaso	12	F	China	460	F
Chad	570	F	Gaza strip	1	F
Djibouti	81	F	India	1500	F
Egypt	210	F	Iran	130	F
Ethiopia	1070	F	Iraq	10	F
Kenya	810	F	Israel	10	F
Libiya	155	F	Jordan	18	F
Mali	250	F	Kuwait	1	F
Mauritania	990	F	Lebanon	1	F
Morocco	33	F	Mongolia	564	F
Niger	363	*	Oman	92	F
Nigeria	18	F	Pakistan	1078	F
Senegal	15	F	Qatar	29	F
Somalia	4000	F	Saudi Arabia	419	F
Sudan	2800	*	Syria	6	F
Tunisia	230	F	Turkey	2	F
			Unitd Arab EM	122	F
			Yemen	185	F
N.C.America	-		Europe	-	
S.America	-		Oceania	-	
			Former USSR	310	F

F = FAO (1993) estimate
Source: FAO (1993)

* = Unofficial figure

Khanna and Rai (1991) studied population dynamics of camel in India. They noticed that Rajasthan State was accounting 58.1 per cent of the total Indian camel population in 1945, which increased to 70.1 per cent in 1982 (Table 2.1.3). However,

Haryana State experienced decline in share in national camel population from 30.3 per cent in 1966 to 11.2 per cent in 1982. There was an increasing trend in camel population of Punjab from 1945 to 1961 followed by decreasing trend, thereafter. The

Table 2.1.3 Statewise and yearwise camel population in India (Thousands)

Sr. No.	State	Year							
		1945	1951	1956	1961	1966	1971	1977	1982
1	Gujarat	-	-	-	44	45	63	56	75
2	Haryana	-	-	-	-	312	133	130	121
3	Himachal Pradesh	-	-	-	-	1	1	1	1
4	Jammu and Kashmir	4	1	1	2	2	3	3	4
5	Madhya Pradesh	1	11	11	16	20	14	12	18
6	Maharashtra	27	39	45 ¹	1 ²	2	1	1	1
7	Manipur	-	-	-	-	-	1	1	1
8	Punjab	117	195	227	224 ¹	119 ²	102	74	64
9	Rajasthan	380	341	436	570	653	745	752	756
10	Uttar Pradesh	32	39	51	43	50	44	38	40
India		654	629	770	903	1028	1109	1068	1078

1 --> Before division 2 --> After division

declining trend in camel population of these two states was attributable to mechanisation of agriculture, improved road systems and reduced interest in camel breeding due to decreased demand. The perusal of data in Table 2.1.3 also make it evident

that the Gujarat State recorded about 70 per cent increase in camel population from 1961 to 1982. Thus it is noteworthy that among the major states having camels, only Rajasthan and Gujarat recorded increasing trend in camel population.

According to the Anonymous (1985) Gujarat was having 62,000 camels of which the Kachchh district had the highest number (28.31 per cent) followed by the districts of Banaskantha (23.80 per cent) and Mehsana (20.89 per cent).

Bhuj (3629), Rapar (3122), Lakhapat (2529), Bhachau (2238) and Nakhatrana (2069) are leading talukas of Kachchh in camel population (Anonymous, 1988).

2.2 DISTINCT PHYSICAL CHARACTERISTICS OF INDIGENOUS CAMEL BREEDS

Camel production represents one of the few sustainable alternatives for supporting human livelihood in extensive, yet ecologically deprived arid zones. However, very little information is available on one-humped camel (*Camelus dromedarius*). The camel breeds are under threat of loss along with breaking down of the traditional social structures. The traditional pastoralists and breeders have played crucial role in preserving and developing many livestock breeds including those of camels. Most of these breeds are adapted to specific and often very harsh environmental situations. For instance, camel breeds of India are able to thrive on scanty vegetation with greater seasonality. Virtually every Indian camel breed is named after its home tract and has distinct phenotypic characters. Therefore, it is vital to document breed characters of Indian camel breeds.

The Indian camels of the plains are classified either as riding type or baggage type. In general, the riding type camels which are localized in deserts are light in weight, have smaller heads, fine muzzles, thin necks, small ears, well developed muscles and comparatively small feet. They are alert and can walk 190 km overnight at a speed of 15 km per hr. The baggage type camels which are mostly riverine, have well developed humps, thick necks, larger heads, broad chests, strong legs and sound foot pads. They can carry weight of about 300 - 400 kg on their back and can walk at a speed of 3.2 km per hr in a day (Anonymous, 1983). They are found in districts of Uttar Pradesh and Punjab. They measure 1.9 to 2.1 m in height.

BIKANERI

The home tract of this breed is Bikaner district of Western Rajasthan which constitute part of Thar desert. It is characterized by its tall height (withers height 2.0 - 2.2 m) and is typically of reddish brown colour, although other shades from sandy to dark brown also exist (Khanna, 1987). The animal is heavy built with average weight varying from 450 kg to 680 kg. The body is symmetrical, elongated and massive. The head is of a medium size and heavy looking with well marked 'strip' (Rathore, 1986). The head is slightly dome shaped. The forehead is well marked with depression above eyes. There is a prominent head crest. The nose ridge tilts upwards. Ears are small, hairy and erect. The 'Jipra' strain of Bikaneri breed has comparatively more abundant heavy tufts of hair around eyes, ears, neck, lower jaws and thick eye lashes, otherwise the Bikaneri camel has short

hairy coat. Neck is medium to long, curved giving graceful carriage of head.

This breed is in high demand as a draught and baggage animal (Anonymous, 1992 and Kohler-Rollefson, 1992).

BAHAWALPUR

Bahawalpur breed of camels has been described as tall and good for both baggage and riding (Hira, 1947 and Kohler-Rollefson, 1992). It is a hardy camel found in Punjab.

JAISALMERI

The Jaisalmeri camel is a typical riding type, bred in the vicinity of the town of Jaisalmer and in the district with the same name that is located on the border towards Pakistan in the most arid part of the Thar desert. It is medium sized, light built and usually of light-brown colour (Kohler-Rollefson, 1992). It has a small head, thin neck, small ears, prominent eyes and a narrow muzzle. It is able to cover 100-125 km or even upto 160 km in a cool night (Rathore, 1986).

JALORI

The animals of this breed are found on the southern side of the river Luni in Rajasthan. This breed is a mixture of Marwari and Jaisalmeri. Their principal use is for draught and ridding purpose.

KACHCHHI

Kachchhi camel is found in Kachchh district of Gujarat State. It is believed that the Kachchhi camel has come from

Sindh. Camels of this breed are restricted to this area and have not spread to other parts of the country probably due to the fact that they are lethargic and ugly looking. They are well adapted to feeding of the vegetation in the salt marshes. They are heavy bodied, and are of grey or dark-brown coloured. Their breeding was practiced by Rajputs, Rabaris, Sindhis and Bharawads communities (Kohler-Rollefson, 1992). The females are good milkers and can give upto 4 to 6 kg of milk in day (Rathore, 1986). These camels are very good for draft purpose but they are bit slow (Anonymous, 1992).

MALVI

The existence of this breed in Mandsaur district of Madhya Pradesh and Chittorgarh area in Rajasthan has been recently reported (Kohler-Rollefson and Rathore, 1995). The most typical external characteristic is its white colour. Unlike other breeds Malvi breeding herds show none of the colour variation. The animal is of small body size, has relatively short legs and is of sturdy built. The male camels are used as work animals, mostly for carrying loads. The females are known for good milk yield. (Kohler-Rollefson, 1992).

MARWARI

This breed is found throughout the whole Jodhpur division except in the Jaisalmer and Jalore districts and a strip border area on the Pakistan side of Barmer district. This breed is heavier in body build and has medium height. The colour is fairly dark (Kohler-Rollefson, 1992). Marwari camel is used both for

agricultural operations transport and occasionally for riding purpose.

MEWARI

Mewari breed is found in Udaipur district of Rajasthan. It was developed from the hilly camels of the Punjab. This camel is stouter and little shorter than the Bikaneri. The muzzle is loose and lower lip droops. Ears are thick and short, set well apart. It is used as pack or baggage animal (Rathore, 1986). It is usually heavy boned, of medium height and light coloured (Koller-Rollefson, 1992).

MEWATI/ALWAR

The hometract of this breed is Alwar and Bharatpur districts of Jaipur division in Rajasthan. The animal is strong and heavier in body build (Anonymous, 1953).

SINDHI

This breed is found on the border of Jodhpur division. This camel is short in stature and its neck is less curved and small. This breed has two distinct types of camel - *Mahri*-riding camel and *Laddu*-baggage camel (Anonymous, 1953). They have longer hair, a dark-brown coat and long nails. They are good for baggage purpose (Rathore, 1986).

SHEKHAWATI (BAGRI)

This breed is found in the Sikar and Jhunjhunu district of Jaipur division in Rajasthan. Shekhawati camels are also found in

Punjab. The breed is big in stature and is mainly used for agricultural operations, transport and riding.

2.3 BODY WEIGHTS

Optimum body weights at a specific age has to be attained by camels for profitable production and reproduction. Indian camels show wide variation in their body weights from birth to maturity as number of genetic and non-genetic factors influence the same. The information available on body weights of native and crossbred camels has been reviewed under following captions:

2.3.1 Birth weight

Birth weight is foremost character which is measurable at the earliest in the life. Knowledge on birth weight of animals is of great importance because of its association with growth and survivability during calf-hood. Average birth weights of native and crossbred camels reported by various workers are presented in Table 2.3.1

Average birth weight ranges between 37.31 ± 0.37 kg (Bhargava *et al.*, 1965) to 45.00 ± 1.17 kg (Anonymous, 1991) in Bikaneri camel. The average value for Kachchhi breed was 38.09 ± 1.11 kg (Anonymous, 1991). However, in Jaisalmeri breed the same was 44.62 ± 1.39 kg (Anonymous, 1991). The average birth weight of Arab X Bikaneri crossbreds was in the order of 37.50 ± 1.25 kg (Khanna *et al.*, 1990^b). Most of the observations on birth weight were on very less number of animals.

Table 2.3.1 Birth weight in native and crossbred camels (kg)

Breed	Male	Female	Pooled	Reference
BIKANERI				
	38.30 ± 0.14	37.27 ± 0.46	37.31 ± 0.37	Bhargava <i>et al.</i> (1965)
	41.84 ± 1.22	38.25 ± 1.00	40.02 ± 1.12	Ram <i>et al.</i> (1977)
	44.34 ± 0.70	44.40 ± 0.54	44.37 ± 0.43	Barhat <i>et al.</i> (1979)
	42.59 ± 0.58	40.55 ± 0.48	41.57 ± 0.48	Barhat and Chowdhary (1980)
	43.32 ± 0.40	41.67 ± 0.38	42.53 ± 0.28	Beniwal and Chaudhry (1983a)
	45.53 ± 6.15	38.86 ± 3.67	-	Anonymous (1987)
	41.95 ± 7.70	39.97 ± 5.32	41.02 ± 0.20	Tandon <i>et al.</i> (1988 ^b)
	38.89 ± 1.01	38.68 ± 0.89	-	Anonymous (1990)
	42.75 ± 1.25	46.67 ± 2.60	45.00 ± 1.17	Anonymous (1991)
	42.15 ± 0.77	38.82 ± 0.64	-	Anonymous (1992)
JAISALMERI				
	27.67 ± 0.56	32.60 ± 2.22	-	Anonymous (1990)
	-	-	28.78 ± 1.30	Khanna <i>et al.</i> (1990b)
	47.67 ± 2.34	43.00 ± 1.89	44.62 ± 1.39	Anonymous (1991)
	36.86 ± 1.18	34.68 ± 1.88	-	Anonymous (1992)

contd...

Table 2.3.1 contd.

Breed	Male	Female	Pooled	Reference
KACHCHHI				
	33.60 ± 3.36	-	-	Anonymous (1987)
	30.17 ± 1.22	32.75 ± 2.47	-	Anonymous (1990)
	38.17 ± 1.58	38.00 ± 1.34	38.09 ± 1.11	Anonymous (1991)
	33.95 ± 0.96	31.47 ± 1.33	-	Anonymous (1992)
ARAB X BIKANERI				
	38.67 ± 0.58	35.75 ± 5.47	-	Anonymous (1987)
	-	-	37.50 ± 1.25	Khanna <i>et al.</i> (1990b)

Birth weight is influenced by several factors contributing to the nourishment of foetus in the uterus. Significant differences in birth weight of camel calves were recorded due to breeds (Khanna *et al.*, 1990^b and Anonymous, 1992), sex (Beniwal and Chaudhry, 1983a; Tandon *et al.*, 1988^b and Anonymous, 1992), parity and/or weight of dam (Beniwal and Chaudhry, 1983a; Tandon *et al.*, 1988^b and Khanna *et al.*, 1990^b) and period of birth (Barhat and Chowdhary, 1980). However, Barhat and Chowdhary (1980) could not record significant effect of month of birth on birth weight of camels. In general the males were heavier at birth than the females and heavier calves were delivered by heavier dams.

2.3.2 Body weights in different age groups

Body weights of native and crossbred camels recorded in different age groups are presented in Table 2.3.2.

Average weight at 3 months was 91.68 to 107.67 kg in Bikaneri and 90.87 to 96.37 kg in Kachchhi (Anonymous, 1985; Khanna *et al.*, 1990^b and Anonymous, 1992). Significant effect of sex but not of breeds on 3 months body weight of camels could be observed (Anonymous, 1992) at NRCC, Bikaner.

Average weight at 6 months was 162.95 to 174.42 kg in Bikaneri and 157.75 kg in Kachchhi camels (Beniwal and Chaudhry, 1983^b and Khanna *et al.*, 1990^b). Sex and sire significantly influenced weight of camels at 6 months of age (Anonymous, 1992).

On an average Bikaneri weighed 211.54 to 238.57 kg and Kachchhi weighed 207.43 kg (Beniwal and Chaudhry, 1983^b and Khanna *et al.*, 1990^b) at one year of age. Significant effects of sex and sire on weight of camels at this age were also reported by Anonymous (1992). Beniwal and Chaudhry (1983^b) noticed significant effects of month and year of birth on body weights upto one year of age in camels.

The data of Table 2.3.2 on body weights at 3, 6, 9 and 12 months of age indicate that Bikaneri and Arab x Bikaneri are slightly heavier, whereas Jaisalmeri are slightly lighter than Kachchhi camels. In general the male camels are heavier than the female ones.

Table 2.3.2 Body weights in different age groups of native and crossbred camels (kg)

Age/Breed	Male	Female	Pooled	Reference
At 3 months				
BIKANERI				
	83.33	85.50	91.68	Anonymous (1985)
	109.60 ±19.89	108.86 ±13.76	-	Anonymous (1987)
	-	-	107.67 ± 2.47	Khanna <i>et al.</i> (1990 ^b)
	-	-	101.92 ± 3.58	Anonymous (1982)
JAISALMERI				
	-	-	94.66 ± 7.05	Khanna <i>et al.</i> (1990 ^b)
	-	-	94.46 ± 5.56	Anonymous (1982)
KACHCHHI				
	95.20 ± 6.53	-	-	Anonymous (1987)
	-	-	96.37 ± 3.77	Khanna <i>et al.</i> (1990 ^b)
	-	-	90.87 ±10.59	Anonymous (1982)
ARAB X BIKANERI				
	134.00 ±14.00	102.83 ±14.29	-	Anonymous (1987)
	-	-	104.00 ± 3.52	Khanna <i>et al.</i> (1990 ^b)
	-	-	103.37 ±10.59	Anonymous (1982)

contd...

Table 2.3.2 contd.

Breed	Male	Female	Pooled	Reference
At 6 month				
BIKANERI				
	163.35 ± 2.02	162.55 ± 2.01	162.95 ± 1.50	Beniwal and Chaudhry (1983 ^b)
	169.58 ±27.17	168.36 ±16.57	-	Anonymous (1987)
	-	-	174.42 ± 3.51	Khanna <i>et al.</i> (1990 ^b)
	170.13 ± 4.26	176.67 ± 5.54	-	Anonymous (1982)
JAISALMERI				
	-	-	135.40 ± 7.97	Khanna <i>et al.</i> (1990 ^b)
	183.00 ± 7.02	170.00 ± 5.40	-	Anonymous (1982)
KACHCHHI				
	157.75 ±15.11	-	-	Anonymous (1987)
	-	-	157.75 ± 7.56	Khanna <i>et al.</i> (1990 ^b)
	181.20 ± 5.22	169.14 ± 8.31	-	Anonymous (1982)
ARAB X BIKANERI				
	179.50 ±14.85	165.83 ±21.45	-	Anonymous (1987)
	-	-	173.00 ± 5.27	Khanna <i>et al.</i> (1990 ^b)

contd...

Table 2.3.2 contd.

Breed	Male	Female	Pooled	Reference
At 12 months				
BIKANERI				
	213.27 ± 2.88	209.81 ± 3.00	211.54 ± 2.14	Beniwal and Chaudhry (1983 ^b)
	246.04 ± 32.60	239.94 ± 15.46	-	Anonymous (1987)
	-	-	238.57 ± 3.80	Khanna <i>et al.</i> (1990 ^b)
	229.18 ± 4.03	223.00 ± 7.41	-	Anonymous (1992)
JAISALMERI				
	-	-	181.67 ± 11.35	Khanna <i>et al.</i> (1990 ^b)
	226.00 ± 23.80	201.20 ± 13.50	-	Anonymous (1992)
KACHCHHI				
	-	-	207.43 ± 4.61	Khanna <i>et al.</i> (1990 ^b)
	202.00 ± 4.71	201.83 ± 7.25	-	Anonymous (1992)
ARAB X BIKANERI				
	-	239.90 ± 21.68	-	Anonymous (1987)
	-	-	229.60 ± 7.56	Khanna <i>et al.</i> (1990 ^b)
Adult				
BIKANERI				
	647.87 ± 106.39	568.95 ± 67.79	-	Anonymous (1987)
	617.33 ± 17.02	577.83 ± 9.79	-	Anonymous (1992)
5-15 years	675.00	539.00	-	Chowdhary (1986 ^a)

contd...

Table 2.3.2 contd.

Breed	Male	Female	Pooled	Reference
JAISALMERI				
	574.80 ±12.73	537.00 ±11.61	-	Anonymous (1992)
KACHCHHI				
	529.50 ±167.03	481.55 ±63.48	-	Anonymous (1987)
	576.75 ±44.73	563.74 ±14.73	-	Anonymous (1992)
ARAB X BIKANERI				
	598.00 ± 0.00	545.00 ± 54.80	-	Anonymous (1991)

Adult body weight in camel is attained by the age of 6 to 8 years depending upon its breed, climatic condition, managemental and nutritional regimes (Pander *et al.*, 1986). Limited published information is available on adult body weights of Indian camels. Average adult body weight was 617.33 to 675.00 kg in male, 539.00 to 577.83 kg in female Bikaneri (Chowdhary, 1986^a and Anonymous, 1992). The adult weight of male and female Kachchhi camel was found to be 529.50 to 576.75 and 481.55 to 563.74 kg respectively (Anonymous, 1987 and Anonymous, 1992). Thus Kachchhi has slightly smaller adult size than Bikaneri camels.

2.3.3 Growth

Beniwal and Chaudhry (1983^a) studied the growth pattern from birth to 30 months of age in Bikaneri camels. Maximum

monthly growth (23.08 kg) was attained in the first 3 months of post-natal life. The average monthly body weight gains after 3 months of age declined steadily upto 24 months of age, possibly due to approach of puberty and anabolic effect of the sex hormones.

Khanna *et al.* (1990^b) compared the growth pattern in Bikaneri, Kachchhi and Arab X Bikaneri crossbred camels from birth to 30 months of age. Average daily weight gain was higher in Kachchhi (800 g/day) from birth to 3 months of age as compared to that in Bikaneri (732 g) and crossbreds (749 g). However, after 3 months of age comparatively higher gain was observed in Bikaneri than in Kachchhi breed. The crossbreds were comparable to Bikaneri at this age.

2.4 BODY MEASUREMENTS AT DIFFERENT AGES

Body weight in conjunction with various body measurements is more reliable in understanding growth pattern of animals. The body measurements are directly associated with skeletal growth of the animal. Therefore, they are commonly used in defining body characteristics of different breeds. Moreover, some of the body measurements have close association with body weight of animal. This can be used in formulating reliable prediction equation for estimation of body weight under field condition where weighing facilities are not available.

Very little critical studies are made on body measurements of camels at different ages.

Table 2.4.1 contd.

1	2	3	4	5	6	7	8	9	10
<u>6 month</u>									
BIKANERI									
	P	158.68 ± 6.15	-	29.78 ± 0.04	83.68 ± 0.99	116.88 ± 1.41	-	46.88 ± 0.67	Anonymous (1987)
DROMEDARIES	M	172.37 ± 26.55	103.87 ± 5.17	31.00 ± 2.39	75.37 ± 5.68	116.37 ± 7.05	123.58 ± 7.69	44.62 ± 5.66	-- do --
	F	165.58 ± 20.40	104.00 ± 5.61	28.87 ± 1.37	74.37 ± 2.45	115.37 ± 2.87	123.25 ± 3.81	43.25 ± 2.12	-- do --
<u>1 year</u>									
BIKANERI									
	P	-	-	-	82.00	115.00	-	-	Chowdhary (1986 ^a)
	P	234.18 ± 6.75	-	32.00 ± 0.38	86.38 ± 0.91	120.88 ± 1.66	-	49.58 ± 0.63	Anonymous (1987)
	P	-	-	-	84.78 ± 1.58	114.78 ± 0.38	-	-	Khanna (1987)
<u>2 year</u>									
BIKANERI									
	P	-	-	-	87.00	121.00	-	-	Chowdhary (1986 ^a)
	P	271.68 ± 6.35	-	37.28 ± 0.32	98.00 ± 1.04	132.28 ± 1.27	-	53.68 ± 0.66	Anonymous (1987)
<u>Adult</u>									
BIKANERI									
	M	-	168.28 ± 1.78	-	-	-	-	68.58 ± 0.79	Sharma and Bhargava (1963)
	F	-	165.86 ± 1.76	-	-	-	-	68.45 ± 0.88	-- do --
	P	-	-	-	115.00	155.00	-	-	Chowdhary (1986a)
	M	-	168.38	-	-	-	-	73.38	Rathore (1986)
	F	-	165.98	-	-	-	-	73.18	-- do --
	P	-	-	-	114.68 ± 3.78	145.88 ± 4.48	-	-	Khanna (1987)
	P	-	168.88 ± 2.93	-	127.68 ± 3.88	152.28 ± 0.73	159.08 ± 1.67	-	Anonymous (1991)

contd...

Table 2.4.1 contd.

1	2	3	4	5	6	7	8	9	10
	M	668.44 ±19.43	165.70 ± 2.06	56.25 ±2.06	129.77 ± 3.27	151.44 ± 1.78	160.55 ± 2.08	-	Anonymous (1992)
	F	592.00 ±25.37	158.20 ± 4.32	54.67 ±1.20	120.00 ± 3.56	140.60 ± 4.12	149.60 ± 3.29	-	-- do --
JAISALMERI									
	P	-	-	-	108.33 ± 3.76	150.00 ± 2.65	157.00 ± 2.98	-	Anonymous (1991)
	M	578.20 ±14.13	156.40 ± 1.62	58.25 ±1.07	119.60 ± 2.93	150.60 ± 3.12	162.00 ± 1.99	-	Anonymous (1992)
	F	592.57 ±19.60	157.28 ± 1.38	54.33 ±1.20	115.28 ± 2.20	140.28 ± 2.68	150.28 ± 2.62	-	-- do --
KACHCHHI									
	P	-	-	-	113.00 ± 3.57	151.00 ± 2.31	162.00 ± 1.00	-	Anonymous (1991)
	M	663.66 ±40.04	156.33 ± 6.76	61.00 ±1.00	111.66 ± 5.27	150.33 ± 2.48	161.50 ± 1.61	-	Anonymous (1992)
	F	533.40 ±30.15	158.00 ± 4.93	57.00 ±0.58	115.40 ± 1.61	138.20 ± 1.38	145.00 ± 1.52	-	-- do --
DROMADERIES									
	P	-	-	41.09	-	-	-	-	Anonymous (1985)
	M	645.13 ±11.97	162.61 ± 1.48	-	118.52 ± 2.00	-	-	-	Anonymous (1991)
	F	592.73 ±19.90	157.86 ± 1.24	-	117.94 ± 0.93	-	-	-	-- do --

M indicates male

F indicates female

P indicates pooled

Average body length of Bikaneri, Jaisalmeri, Kachchhi and crossbreds at birth was more or less in similar range (62.00 to 65.69 cm). The body length of Kachchhi camels was minimum in the group (Anonymous, 1992).

Average body length of Bikaner; Jaisalmeri and Kachchhi adult male camel was 165.70 to 168.30; 156.40 and 156.33 cm, respectively. The same for adult female camel was 158.20 to 165.90; 157.28 and 158.00 cm, respectively (Sharma and Bhargava, 1963; Rathore, 1986 and Anonymous, 1992). The Bikaneri camels had longer body than Jaisalmeri and Kachchhi in adulthood. The sex difference was not that distinctive for body length in Kachchhi (Anonymous, 1992).

The data of Table 2.4.1 indicated that length of the face in Bikaneri, Jaisalmeri and Kachchhi was 54.67 and 56.25; 54.33 and 58.25; and 57.00 and 61.00 cm in female and male adult camel, respectively. Thus Kachchhi camel had slightly longer face than the Bikaneri and Jaisalmeri. The female had shorter face than the male (Anonymous, 1992).

The average length of neck (Table 2.4.1) in Bikaneri, Jaisalmeri and Kachchhi was 120.00 to 129.77; 115.28 to 119.60 and 111.40 to 115.40 cm in adult camels, respectively (Anonymous, 1992). The Bikaneri camels had slightly longer neck than the other camel breeds. The sex difference had no clear trend.

The average linear measurement of fore leg (Table 2.4.1) in Bikaneri, Jaisalmeri and Kachchhi was 140.60 to 151.44; 140.28

to 150.60 and 138.20 to 150.33 cm in female and male adult camels, respectively. Thus breed difference in length of fore leg was minor. The males had longer fore legs than females (Anonymous, 1992).

Average length of hind leg (Anonymous, 1992) in Bikaneri, Jaisalmeri and Kachchhi was 149.60 and 160.55; 150.28 and 162.00 and 145.80 and 161.50 cm in adult female and male camels, respectively. Thus breed differences in length of hind leg was minor. The males had longer hind legs than females.

Average length of tail was 29.46 to 31.50 cm at birth (Bhargava et al., 1985) and that at adult age 60.45 to 60.58 cm (Sharma and Bhargava, 1963) in female and male Bikaneri camels. The length of tail almost doubled at adult age than that at birth.

2.4.2 Height of body parts

Average length of important body parts in native and crossbred camels has been summarised from available literature in Table 2.4.2.

Height at wither is one of the most important body measurement for animals. It was commonly studied for camels at different ages to described physics of the animals in different breeds. Average height at withers in Bikaneri, Jaisalmeri, Kachchhi and crossbred (Anonymous, 1992) at birth was 108.96, 106.36, 102.00 and 108.53 cm, respectively. Average height at withers in Bikaneri, Jaisalmeri and Kachchhi adult female and

Table 2.4.2 Height of important body parts in native and crossbred camels (cm)

Breed/ Age group	Sex	Height at withers	Height at hump	Height at pin bone	Height at hock	Reference
1	2	3	4	5	6	7
<u>At birth</u>						
BIKANERI						
	M	117.87 ± 1.17	122.68 ± 0.84	91.95 ± 1.32	46.48 ± 1.82	Bhargava et al. (1965)
	F	113.28 ± 0.79	117.86 ± 1.82	94.97 ± 0.69	46.74 ± 0.81	-- do --
	P	119.00	121.00	-	-	Chowdhary (1986 ^a)
	P	108.96 ± 0.87	-	-	-	Anonymous (1992)
JAISALMERI						
	P	106.36 ± 1.18	-	-	-	Anonymous (1992)
KACHCHHI						
	P	102.00 ± 1.82	-	-	-	Anonymous (1992)
CROSSBRED						
	P	108.53 ± 2.11	-	-	-	Anonymous (1992)
<u>3 month</u>						
DROMADERIES						
	M	131.75 ± 7.03	-	-	-	Anonymous (1987)
	F	134.62 ± 3.89	-	-	-	-- do --
<u>6 month</u>						
DROMADERIES						
	M	151.75 ± 11.45	-	-	-	Anonymous (1987)
	F	151.37 ± 5.32	-	-	-	-- do --
<u>1 year</u>						
BIKANERI						
	P	165.00	172.00	-	-	Chowdhary (1986 ^a)
	P	160.40 ± 0.92	-	-	-	Anonymous (1987)

contd...

Table 2.4.2 contd.

1	2	3	4	5	6	7
2 year						
BIKANERI						
	P	170.00	183.00	-	-	Chowdhary (1986 ^a)
	P	180.10 ± 1.13	-	-	-	Anonymous (1987)
DROMADERIES						
	M	166.94 ± 1.61	-	-	-	Anonymous (1991)
	F	162.53 ± 1.39	-	-	-	-- do --
Adult						
BIKANERI						
	M	207.26 ± 1.52	229.99 ± 1.98	162.43 ± 1.34	66.42 ± 0.94	Sharma and Bhargava (1963)
	F	198.37 ± 0.11	214.88 ± 1.36	151.38 ± 1.57	64.00 ± 1.14	-- do --
	P	206.00	211.00	-	-	Chowdhary (1986 ^a)
	M	207.30	-	-	-	Rathore (1986)
	F	198.40	-	-	-	-- do --
	P	208.20 ± 2.58	-	-	-	Anonymous (1991)
	P	206.67 ± 1.76	-	-	-	-- do --
	M	209.22 ± 2.52	-	-	-	Anonymous (1992)
	F	195.68 ± 5.45	-	-	-	-- do --
JAISALMERI						
	P	199.33 ± 4.48	-	-	-	Anonymous (1991)
	M	206.40 ± 2.37	-	-	-	Anonymous (1992)
	F	191.85 ± 2.12	-	-	-	-- do --

contd...

Table 2.4.2 contd.

1	2	3	4	5	6	7
KACHCHHI						
P	199.33 ± 1.33	-	-	-	-	Anonymous (1991)
M	195.83 ± 4.89	-	-	-	-	Anonymous (1992)
F	189.80 ± 3.29	-	-	-	-	-- do --
DROMADERIES						
M	207.13 ± 1.49	-	-	-	-	Anonymous (1991)
F	193.03 ± 1.12	-	-	-	-	-- do --

M indicates male

F indicates female

P indicates pooled

male was 195.60 and 209.22; 191.85 and 206.40; and 189.80 and 195.83 cm, respectively. Critical examination of the data (Anonymous, 1992) clearly indicated that the Bikaneri was taller and Kachchhi was shorter in height at birth as well as in adulthood. As a general trend the males were taller than the females.

2.4.3 Circumference of body parts

Circumference of important body parts in native and crossbred camels has been presented in Table 2.4.3.

Heart girth is commonly employed in estimation of body weight of an animal because of relationship between the two circumference of body at chest (heart girth) was invariably included in studies in biometry of camels.

Table 2.4.3 Circumferences of important body parts in native and crossbred camels (cm)

Breed/ Age group	Sex	Heart girth	Neck at base	Neck at head	Fore foot pad	Hind foot pad	Reference
1	2	3	4	5	6	7	8
<u>At birth</u>							
BIKANERI							
	P	88.36 ±0.98	-	-	-	-	Anonymous (1992)
JAISALMERI							
	P	79.74 ±1.23	-	-	-	-	Anonymous (1992)
KACHCHHI							
	P	74.58 ±1.19	-	-	-	-	Anonymous (1992)
CROSSBRED							
	P	78.29 ±2.28	-	-	-	-	Anonymous (1992)
<u>3 month</u>							
DROMEDARIES							
	M	126.58 ± 8.77	-	-	37.58 ±4.84	33.75 ±3.81	Anonymous (1987)
	F	123.87 ± 6.83	-	-	34.12 ±3.76	31.75 ±3.73	-- do --
<u>6 month</u>							
BIKANERI							
	P	148.18 ± 1.69	-	-	-	-	Anonymous (1987)
DROMEDARIES							
	M	145.81 ±11.15	-	-	43.75 ±4.59	39.37 ±4.53	Anonymous (1987)
	F	144.25 ± 5.12	-	-	42.25 ±4.33	37.37 ±2.27	-- do --
<u>1 year</u>							
BIKANERI							
	P	158.88	-	-	-	-	Chowdhary (1986 ^a)
	P	153.48 ± 1.78	-	-	49.88 ±8.59	45.28 ±8.55	Anonymous (1987)
<u>2 year</u>							
BIKANERI							
	P	168.88	-	-	-	-	Chowdhary (1986 ^a)
	P	172.18 ± 1.73	-	-	54.48 ±8.47	49.28 ±8.47	Anonymous (1987)

contd...

Table 2.4.3. contd.

1	2	3	4	5	6	7	8
DROMADERIES							
	M	162.89 ± 1.39	-	-	-	-	Anonymous (1991)
	F	161.48 ± 1.48	-	-	-	-	-- do --
Adult BIKANERI							
	M	199.39 ± 1.52	-	-	-	-	Sharma and Bhargava (1963)
	F	188.72 ± 1.48	-	-	-	-	-- do --
	P	215.88	-	-	-	-	Chowdhary (1986 ^a)
	M	199.48	-	-	-	-	Rathore (1986)
	F	188.78	-	-	-	-	-- do --
	P	224.28 ± 1.69	-	-	-	-	Anonymous (1991)
	P	225.88 ± 2.65	-	-	-	-	Anonymous (1991)
	M	223.11 ± 2.55	113.44 ± 5.48	74.88 ± 1.64	73.89 ± 1.77	62.44 ± 0.89	Anonymous (1992)
	F	215.88 ± 4.22	92.68 ± 2.35	57.88 ± 1.35	67.48 ± 1.28	59.28 ± 1.15	-- do --
JAISALMERI							
	P	216.33 ± 4.48	-	-	-	-	Anonymous (1991)
	M	218.28 ± 3.86	98.88 ± 2.99	64.88 ± 1.81	75.68 ± 1.82	64.68 ± 0.98	Anonymous (1992)
	F	211.38 ± 2.38	92.85 ± 1.85	56.71 ± 0.97	66.42 ± 1.11	56.85 ± 0.88	-- do --
KACHCHHI							
	P	219.33 ± 2.67	-	-	-	-	Anonymous (1991)
	M	286.33 ± 5.78	97.33 ± 6.88	66.61 ± 3.49	75.66 ± 2.83	66.58 ± 1.28	Anonymous (1992)
	F	214.38 ± 2.99	94.38 ± 2.14	54.98 ± 0.99	68.28 ± 0.81	59.98 ± 0.99	-- do --

contd...

Table 2.4.3 contd.

1	2	3	4	5	6	7	8
MALVI							
	F	286.38 ± 1.50	-	-	-	-	Kohler Rollefson and Rathore (1995)
	F	214.00 ± 0.00	-	-	-	-	-- do --
DROMADERIES							
	M	220.30 ± 1.62	-	-	-	-	Anonymous (1991)
	F	212.51 ± 2.26	-	-	-	-	-- do --

M indicates male

F indicates female

Average heart girth of Bikaneri, Jaisalmeri and Kachchhi (Anonymous, 1992) at birth was 80.36, 79.74 and 74.50 cm, respectively. The same measurement for Bikaneri, Jailsalmeri and Kachchhi adult female and male was 215.00 and 223.11, 211.28; and 210.20 and 214.30 and 208.33 cm, respectively. The Bikaneri camels at birth as well as at adult age were having larger heart girth than the Jaisalmeri and Kachchhi at the respective ages. This was in concomitant with the observations on body weights of three breeds indicating closer relationship between the two traits.

Average circumference of neck at base in Bikaneri, Jaisalmeri and Kachchhi was 92.60 and 113.44, 92.85 and 98.00; and 94.30 and 97.33 cm in adult female and male camels, respectively. The average circumference of neck at head in Bikaneri, Jaisalmeri and Kachchhi was 57.80 and 74.00, 56.71 and 64.00; and 54.90 and 66.61 cm in adult female and male camel,

respectively (Anonymous, 1992). The Bikaneri were having thicker necks throughout its length than the Jaisalmeries and Kachchhies. The males were having similarly thicker necks than the females in the three breeds studied. The neck was thicker in the camel at the base than that at the head.

Average circumference of fore foot pad of Bikaneri, Jaisalmeri and Kachchhi in adult female and male was 67.40 and 73.89, 66.42 and 75.60; and 68.20 and 75.66 cm, respectively. The average circumference of hind foot pad in Bikaneri, Jaisalmeri and Kachchhi was 59.20 and 62.44, 56.85 and 64.60; and 59.90 and 66.50 cm in adult female and male camels, respectively (Anonymous, 1992). The breeds did not differ much in the measurement in the fore as well as hind foot pads. The fore feet were having larger foot pads than the hind ones. The males were having larger foot pads than the females.

2.4.4 Relation between body weight and biometrical measurements

The relationship of body weight and biometrical measurements in camels has not been much exploited. Very few systematic studies have been made on this issue in India and abroad.

Bucci *et al.* (1984) could established positive and very significant correlation ($r = 0.80$) between body weight and abdominal circumference at hump in adult Sudanese Beshari or Abbadi camels. They have given prediction equation for body weight in this camel as under:

$$Y = 3.06X - 290.60$$

where, Y = body weight in kg

X = circumference at hump in cm

Khanna *et al.* (1990b) from NRCC, Bikaner attempted to correlate body weights at various ages with 13 biometrical parameters in Bikaneri, Jaisalmeri, Kachchhi and crossbred camels. Significant correlation coefficients existed between body weight and heart girth, and heart girth and leg length in all the age groups. Body weight at 6 months, 2 years and 3 years of age had very high correlation with heart girth at the respective age. Following prediction equations for body weights in the camels were worked out.

Body weight (kg) at

$$8 \text{ months} = 2.68 \times \text{heart girth} - 217.10$$

$$2 \text{ years} = 3.88 \times \text{heart girth} - 355.40$$

$$3 \text{ years} = 4.42 \times \text{heart girth} - 429.37$$

Relationship of biometrical measurements with body weights in Bikaneri, Jaisalmeri, Kachchhi and crossbred camels was studied at NRCC, Bikaner (Anonymous, 1991). Phenotypic correlations between body weight and biometrical parameters have been presented in following table.

Particulars	AGE GROUP			
	0 - 1 year		Above 4 year	
	Male	Female	Male	Female
Body length	0.8307	0.6213	0.7175	0.3175
Height at withers	0.9108	0.5076	0.4127	0.1553
Heart girth	0.9465	0.6778	0.7723	0.5816
Neck length	0.3853	0.7234	-0.2863	0.1171

The correlation coefficient between body weight and biometrical parameters studied were all highly positive in young animals. However, they were higher and positive between body weight with either body length or heart girth in adults of both the sexes.

Tahir (1982) from University of Basrah, Basrah, Iraq studied correlation between live body weight and some body measurements in growing and adult single humped male camels. The live body weight (kg) was positively and highly correlated ($P < 0.01$) with all the body measurements (cm) viz., body length, neck length, heart girth, circumference at hump, circumference at flank, height at wither, height at hump and height at hip. He worked out following prediction equations for live body weight in the camels from body measurements of high correlation values.

$$\text{Body weight (kg)} = 3.176 \times \text{HG} - 257.398$$

$$\text{Body weight (kg)} = 2.514 \times \text{CH} - 224.126$$

$$\text{Body weight (kg)} = 4.052 \times \text{CF} - 249.783$$

$$\text{Body weight (kg)} = 4.139 \times \text{HW} - 425.081$$

$$\text{Body weight (kg)} = 3.624 \times \text{HH} - 401.169$$

$$\text{Body weight (kg)} = 5.127 \times \text{HP} - 564.911$$

where; HG = Heart girth
 CH = Circumference at hump
 CF = Circumference at flank
 HW = Height at withers
 HH = Height at hump
 HP = Height at hip

2.5 REPRODUCTION IN CAMEL

The camels are having proven utility under harsh agro-climatic situation. However, they are often blamed for their very slow herd growth, largely due to their longer calving interval. The scanty and uncertainty in feed availability might have forced the breeders to take calves from the dams at longer interval. By this way, they can avoid stress on the animals. Systematic and scientific approach for improvement in their reproductive performance is required for making camel production sustainable.

2.5.1 Sexual maturity and age at first service

2.5.1.1 Females

The puberty is exhibited by appearance of oestrus. First oestrus was observed in dromedary female camel between 2 years (Arthur *et al.*, 1985) to 3 years of age (Leupold, 1968 and Williamson and Payne, 1978).

Chowdhary (1986^a) reported age at first heat of 39 to 52 months in Indian dromedaries. However, Rathore (1986) observed that puberty was attained at around 5 years of age in Indian female camels.

Age of sexual maturity was reported to occur in one humped she-camel from three (Matharu, 1966; Leupold, 1968; Arthur *et al.*, 1985 and Schwartz, 1992) to four years (Yasin and Wahid, 1957; Singh, 1966 and Williamson and Payne, 1978).

According to Chaudhry and Beniwal (1983) and Pander *et al.* (1986), the Indian camels attain the adult age at 6 to 8 years, though the sexual maturity is reached by 5 to 6 years of age.

The information on age at first service for native breeds of camels is summarised in Table 2.5.1. It can be concluded from the table that average age at first service was varying from 1040.83 to 1487.75 days in Indian breeds of camels kept on farms located in Rajasthan (Anonymous, 1987 and Anonymous, 1991). According to Yasin and Wahid (1957) the female camel was first mated at 4 years of age in Pakistan. Aboul-Ela (1994) reported average age at first service of 43.1 ± 0.58 (1293.00 days) months in U.A.E dromedaries.

Kamoun and Wilson (1994) while comparing growth and early reproduction of camels reared in field with those reared on research station, observed that adequate nutrition during the pre and post-weaning period helped in attaining age of puberty and first conception earlier.

Apparently there is no systemic control on age at which young camel heifers are put to mating in the field. Normally, the females are withheld from breeding until they are 4 to 6 years old (Matharu, 1966 and Williamson and Payne, 1978).

Table 2.5.1 Breeding performance of native camel breeds

Breed	Location	Age at first service (days)	Age at first calving (days)	Gestation length (days)	Calving interval (days)	Reference
1	2	3	4	5	6	7
BIKANERI	Bikaner	-	-	389.87 ± 2.10 (33)	-	Mehta et al.(1962)
	--do--	-	-	386.52 ± 1.75 (60)	-	Barhat et al.(1979)
	--do--	-	1855.60 ± 29.72 (105)	-	-	Beniwal and Chaudhry (1984)
	NRCC Bikaner	1390.00 ± 25.00 (60)	1882.00 ± 28.69 (93)	389.33 ± 0.08 (532)	771.66 ± 8.08 (592)	Khanna et al.(1990 ^b)
	--do--	1424.97 ± 41.41 (66)	1855.51 ± 40.18 (75)	381.85 ± 1.17 (111)	741.89 ± 9.83 (91)	Anonymous (1992)
JAISALMERI	--do--	1412.99 ± 16.50 (2)	-	384.72 ± 3.88 (18)	676.00 ± 19.36 (5)	Anonymous (1992)
KACHCHHI	--do--	1094.50 ± 3.42 (6)	-	381.67 ± 5.69 (27)	738.40 ± 10.69 (10)	Anonymous (1992)
DROMADERIES	-	-	-	370.00 to 390.00	-	Matharu (1966)
	Bikaner	-	-	404.32 ± 4.82 (56)	-	Ram et al.(1977)
	NRCC Bikaner	1387.14 (60)	1882.30 (93)	-	-	Anonymous (1985)
	contd...	-	-	383.00 ± 9.00	-	Agarwal et al. (1987 ^b)

Table 2.5.1 contd.

1	2	3	4	5	6	7
	NRCC	1487.75	1818.31	398.20(M)	665.88	Anonymous (1987)
	Bikaner	± 298.11	± 316.53	± 11.56 396.67(F) ± 13.63	± 93.63	
	--do--	1188.73 ± 34.57 (11)	1489.88 ± 22.81 (5)	382.38 ± 2.17 (48)	713.85 ± 20.48 (20)	Anonymous (1998)
	--do--	1848.83 ± 5.39 (6)	1491.17 ± 6.48 (6)	387.88(M) ± 2.76 388.47(F) ± 2.88 (12)/(15)	713.49 ± 9.69	Anonymous (1991)
	Gujarat field	-	-	389.72 ± 8.87 (116)	783.46 ± 18.84 (98)	Prajapati (1993)

(M) indicates that dam delivering male calf

(F) indicates that dam delivering female calf

Figures in the parenthesis indicate number of observations.

2.5.1.2 Males

The attainment of puberty is influenced by the overall growth and weight of the animal. Leupold (1968) reported that sexual maturity was attained in male camel at 3 years of age. Singh (1966), Arthuret al.(1985) and Schwartz (1992) stated that though the male camels was showing sexual activity at 2 to 3 years of age, the rutting or sexual maturity was observed at 6 years of age. Khanna et al.(1987) although observed sexual desire from 3 to 4 years of age in Bikaneri males, the normal rutting was observed only at around 5 to 6 years of age. Khan and Kohli (1972) noticed average rutting age in dromedaries to be 6 years.

The male camels were continued into breeding programme upto 12 years of age in Kenya (Schwartz, 1992).

It is well known that mature male camels show a seasonal sexual activity, referred to as the 'rut'. Behavioural changes like aggressiveness, making territory, placing urine on the body, restlessness, loss of appetite and weight loss are the main signs of rutting (Khanna *et al.*, 1987).

The male camel in 'rut' expresses characteristic symptoms like aggressiveness, secretion from poll glands, protrusion of soft palate ball out of the mouth, production of gurgling sound and adoption of peculiar postures (Khan and Kohli, 1972).

According to Matharu (1988) native male camel has a distinct period of sexual activity (the rut), which may last for a month or so. The rutting period generally starts from December and lasts upto March. For the rest of the months in a year breeding instinct is suppressed. He also observed that when a number of camels are living together only one, the strongest or the most vigorous becomes "musth", the remainder of the herd keep quite out of fear of the stronger companion. During this season camels are liable to fall off in condition to a marked degree, which is due both to partial loss of appetite and to the wind sucking and belching from which the camel gets little rest. If he is put to hard work, his sexual inclination declines or disappears.

The actual duration of the rut depends largely on the condition of the animal (Singh, 1966). It was noticed that the intensity of rutting signs in male camels was related to their age (Khan & Kohli, 1972). Mature animals were furious as compared to younger and older stock.

During rutting season the testes weigh the heaviest and the level of spermatozoa in the epididymis reach maximum (Charnot, 1964). Agarwal *et al.* (1987^a) reported higher level of testosterone during breeding season in camels.

Ideal ratios of male to female camels during breeding season are variously stated to be 1:30-50 (Singh, 1966); 1:40-50 (Schwartz, 1992) and 1:50-70 (Matharu, 1966 and Leupold, 1986).

Khanna *et al.* (1987) recommended a ratio of one male to 20-25 female camels under Indian condition. They also suggested that keeping extra males was desirable to provide genetic diversity and to check inbreeding for wider and efficient selection.

2.5.2 Breeding seasons

Wilson (1989) in his review paper reported seasonality in breeding behaviour of camels under field conditions. The breeding season so recognized is much more extensive than generally observed. This is largely due nutritional status of the animals.

Singh and Prakash (1964) reported that she-camel remains in heat in winter till she conceives. However, Matharu (1966)

reported that she-camel shows estrus from November to March depending on the plane of nutrition. Similar findings were also reported by Khanna *et al.* (1990^b).

The male camel is found to be sufficiently competent to identify a female in heat during November to February (Singh and Prakash, 1984) and Khan and Kohli (1972). However, according to Chowdhary (1986^a) breeding season for stud camel is ranging from November to March.

Seasonality in camel breeding is leading to seasonality in camel births. Birth season in camels have been recorded to extend from November to March in India (Khanna *et al.*, 1990^b).

Arthur *et al.* (1985) observed birth season between December and February in Eastern Province of Saudi Arabia. Schwartz (1992) reported birth season in nomadic herds of Kenya to vary from November to May with higher number of birth in December, January and May.

2.5.3 Signs of oestrus

Oestrus is the most vulnerable time in the sexual life of an adult she-camel as only during this period conception can occur. Physiology of oestrous cycle in camel is almost similar to that in equines (Joshi *et al.*, 1978). Usually the oestrus is exhibited five times in a breeding season (Gupta *et al.*, 1978). On the other hand Novoa (1970) observed that the sexual activity in camelids is acyclic.

The signs of oestrus in she-camel are relatively less pronounced than signs of rutting in males who become aggressive during breeding season (Novoa, 1970 and Chaudhry and Beniwal, 1983). Further, it must be stressed that the external signs of heat in the camel are less evident than in the cow and mare (Musa and Abusineian, 1978^b).

Singh (1966) and Arthur *et al.* (1985) reported that the most characteristic signs of oestrus are restlessness, wondering about in search of mate, frequent bleating, swelling of vulva and discharge of mucous from the genital opening. The she-camel moves its tail up and down in rapid succession on the approach of the male or when hearing the gurgling voice of the rutting male.

Chowdhary (1986^a) observed that females in oestrus go to the male, generally when the oestrus is very intense. The male detects females in oestrus mainly by smell.

Average length of oestrous cycle in camels varies between 21 to 24 days (Nawito *et al.*, 1967 and Joshi *et al.*, 1978).

Oestrus usually occurs after one year of calving in camels (Williamson and Payne, 1978) but if well fed may appear within one month post-partum (Matharu, 1966; Williamson and Payne, 1978 and Abdel-Rahim *et al.*, 1994).

2.5.4 Length and signs of pregnancy

Livestock owners are interested in knowing length of gestation period in camels because of its use in predicting

calving date and of believed relationship between the length of gestation and the sex of calf.

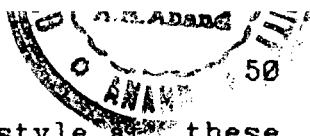
The information on average length of gestation period for indigenous camel is presented in Table 2.5.1. On an average length of gestation period in Indian breeds of camels ranged from 381.85 ± 1.17 to 404.32 ± 4.82 days (Ram *et al.*, 1977 and Anonymous, 1992).

Average gestation length has been recorded in the range of 12 to 13 months (365 to 390 days) in camels of Pakistan (Yasin and Wahid, 1957) and 13 months (390 days) in camels of Turkman (Abdunazarov, 1971) and 370 to 375 days in camels of Saudi Arabia (Arthur *et al.*, 1985) and in camels of Kenya 370 to 390 days (Wilson, 1986 and Schwartz, 1992).

Wilson (1988) studied the reproductive performance and survival of one humped young camels in commercial ranches in Kenya. They reported that length of gestation period was not significantly affected either by herd, month of conception, sex of calf or age of dam.

The difference in the gestation period of calves between two sexes was found statistically non-significant in Indian dromedaries (Anonymous, 1985). Ram *et al.* (1977) observed significant effect of sire on gestation length in Indian camel.

Pregnant female camels lift the tail and curl it up in a typical style on being approached by the males. The lifting of tail is sometimes seen both during anoestrus and oestrus (Musa



and Abusineina, 1978^a), but there is variation in style at these two occasions. This behaviour has been found to be fairly correct method of pregnancy diagnosis after 4 weeks.

Singh (1966) reported that this behavioural sign of curling tail by the female camel was found after 15 days of service whereas Rathore (1986) observed the sign after 15 to 25 days of conception. Studies of Banerjee *et al.* (1981) revealed that the behavioural sign was observed on 28.8 ± 2.0 days after conception in camel.

Chawdhary (1986^a) reported successful detection of pregnancy by the behavioural sign as early as 7 to 15 days of conception. This test confirmed pregnancy in 99 per cent cases.

Singh (1966) noticed enlargement of belly after about six months of pregnancy in the female camel.

2.5.5 Age at first calving

The information reviewed on age at first calving for native breeds of camels is summarised in Table 2.5.1. It is revealed from the table that average age at first calving in the Indian camels ranged between 1489 to 1882 days under farm condition in Rajasthan (Anonymous, 1990 and Khanna *et al.*, 1990^b).

Beniwal and Chaudhry (1984) critically analysed data of 15 years on 105 Bikaneri camels of Camel Breeding Farm, Bikaner. The period but not month of birth had significant effect on the age at first calving of the camels. The age at first calving

was reduced over the years. The heritability estimate for the trait was very low (0.03 to 0.40) in herd indicating environment had greater influence on the trait.

Reproductive performance of one humped camels on 4 Kenyan commercial ranches was collected and analysed by Wilson (1986). Average age at first calving was 54.3 ± 6.2 months (1630 days). The differences due to ranches were non-significant.

Aboul-Ela (1994) studied reproductive performance in 2 herds of one humped camel under traditional management in the United Arab Emirat. He recorded average age at first calving of 55.3 ± 2.87 months (1660 days) in the camels.

2.5.6 Calving interval

Critical study of the data presented in the Table 2.5.1 indicated that average calving interval ranged from 676.00 ± 19.36 day in Jaisalmeri to 771.66 ± 8.08 days in Bikaneri camels with the value of 738.40 ± 10.69 days in Kachchhi camels (Khanna *et al.*, 1990b and Anonymous, 1992).

Anonymous (1990) reported that the calving interval in the Indian camel is long because of seasonality in breeding. Their results further revealed that the calving interval exhibited decreasing trend with the increasing age upto 5th parity. Thereafter, it showed reverse trend. However, the parity and year of birth did not have significant effects on the trait.

Exotic dromedaries had average calving interval of 20.2 ± 5.3 months (606 days) in Kenya (Wilson, 1986) and 24.4 ± 0.68 months (732 days) in U.A.E (Aboul-Ela, 1994).

The study of Wilson (1986) indicated that calving interval was significantly affected by the herd, parity of the dam as well as by the survival of the previous calf.

2.5.7 External signs of approaching parturition

Parturition is a critical event in the life of mammalian female. Special care and management is required not only to facilitate comfortable parturition, but also for better survival of the young one and better sexual health of the mother. Therefore, livestock owners should know the signs of parturition.

Prakash and Singh (1982), Burgemeister (1978) and Khanna *et al.* (1987) have described signs of parturition in camels. The important extrnal signs are as under:

The vulva and udder begin to enlarge one week before expected date of calving. The udder is distended with milk, teats point downward and forward. The sacrociatic ligaments of rumps relax forming two grooves. The superficial mammary veins become tense and tortuous. The abdomen exhibits pendulous look. The vulvar lips are swollen and relaxed.

The parturient mother gets restless and tends to separate from the herd as calving approaches. Lyingdown of mother on her side is an an important external sign shown by her before the

onset of parturition. Sometimes, calving occurs in the standing position. During the first stage, a Whitish translucent amnion sac appears at the vulva. The posture and presentation of foetus is generally anterior. But rarely posterior presentation and breech presentations are also noticed. The process of parturition usually takes about 30 to 45 minutes.

2.6 MILK PRODUCTION

Milk production is a characteristic of mammals and is primarily produced for nourishment of their young ones. Therefore, milk production of dam has a vital role in early growth and survival of the young ones. Apart from this, surplus milk from them is utilized by humanbeings. Camel milk is generally consumed by camel keepers for their house hold purposes. Yet, there is no organised market for camel milk in India.

The camel milk is not only known for its nutritional value but is of great importance in desert area where both water and food are scarce.

The colostrum of camels is white and slightly diluted as compared with the colostrum of the cow (Rao *et al.*, 1970 and Yagil and Etzian, 1980).

2.6.1 Milk yield

Data on milk yield of camels are compiled and presented in Table 2.6.1. It is revealed from the table that Kachchhi camels

have better milk yield than other breeds of Indian camels and is quite comparable to that of exotic camels.

Yagil (1987) has reviewed literature on camel milk production. In his review paper, he emphasised need for selection and breeding of camels considering their milk yield as these animals of arid zones have greater potential for the same. The milk yield of camels is not that affected by arid hotter climate and scarcity of water. Most of the camels are milked twice a day. However, camels are milked according to immediate needs resulting into not milking for a few days to 6 or more times milking in a day. There are reports indicating increasing in milk yield with the increase in milking frequency in camel.

Table 2.6.1 Milk yield of camels

Country	Daily milk yield (kg)		Lactation length (days)	Reference
	<i>Mean</i>	<i>Maximum</i>		
Middle East and Africa	3.5-35 L	-	-	Knoess (1980)
India				
BIKANERI	4.5	-	213 to 547	Sharma and Bhargava (1963)
	3.8-10.8	-	-	Khanna <i>et al.</i> (1990 ^b)
	3.8-11.0L	14.0L	-	Anonymous (1992)
JAISALMERI	3.0-8.0L	-	-	Anonymous (1992)
KACHCHHI	4-6	10.0	-	Rathore (1986)
	5.2-14.6L	18.0L	-	Anonymous (1992)
(field)	4.0-10.0L	15.16L	-	Anonymous (1992)
	2-6			Kohler-Rollefson (1992)
MALVI(field)	2.0	5-6	-	Kohler-Rollefson and Rathore (1995)

L denotes litres

In a study at NRCC, Bikaner (Anonymous, 1992) involving 6 Bikaneri camels, it was observed that on an average 3.99 ± 0.24 L to 7.04 ± 0.55 L of milk was produced per day per animal. The milk production increased upto seventh month of lactation and thereafter it started declining. The milk production from the rear teats was higher than the front teats by 23.4 to 35.4 per cent at different stages of lactation except for first two months.

Farah (1993) had made review on milk production in camels. He noticed that on an average camels are milked for about 12 months, but it may vary from 9 to 18 months, depending on management and environmental conditions. The calves are allowed to suckle throughout the lactation. He described camel as a potential milker than many African Zebu cows.

Daily milk yield in Indian camel may range from 3.5 to 10.0 kg as reported by Khanna and Rai (1993).

Average lactation length in she-camels is about 12 months but it may vary from 9 to 18 months depending on management and environmental condition (Khanna, 1986^a and Farah, 1993).

She-camel is milked in standing position. As soon as the calf starts suckling, the letdown takes place. If calf is dead, the she-camel may adopt a boy or girl and in their presence after smelling them the letdown may take place (Chowdhary, 1986^b).

2.6.2 Gross composition of milk

Camel milk is generally opaque-white. The pH of camel milk ranges from 6.5 to 6.7 with an average values of 6.56 and density from 1.025 to 1.032 with an average of 1.029. Both values are lower than those of cow's milk (Rao *et al.*, 1970; Shalash, 1980 and Sawaya *et al.*, 1984).

One of the important factor that affects camel milk composition is the water intake by the camel. Yagil and Etzion (1980) examined the effects of restricting drinking water on camel milk. While the diet remained unchanged throughout the year, great changes in water content of milk were found. When drinking water was freely available, the water content of the milk was 86 per cent. However, when drinking water was restricted, the water content of milk rose to 91 per cent. The study indicated that the lactating camel losses water to the milk during drought. This could be a natural adaptation in order to provide necessary fluid to the dehydrated calf.

Information collected on the composition of camel milk is presented in Table 2.6.2. The data of the table indicate that camel milk has fat from 2.0 to 5.5 per cent, protein from 2.0 to 5.0 per cent, lactose from 2.90 to 5.80 per cent and ash from 0.35 to 0.95. The total solids varies from 9.75 to 14.30 in the camel milk. The difference among the various sets of data undoubtedly reflect differences in breed, stage of lactation of the animals sampled and perhaps in analytical procedures as well.

Anonymous (1990) could not find any significant difference in the chemical composition of milk from Bikaneri and Kachchhi.

Camel milk taste is bitter, salty and sweet. It has powerful cathartic properties. The bitter taste and action on the alimentary tract are determined by the type of fodder that is eaten. Grazing high salt containing fodder like halophytes will impart a salty taste to the milk and irritate the gut, however, other plants give a bitter taste. When the camels eat the same food as cows, the milk has the same sweet taste (Yagil, 1987).

Table 2.6.2 Gross composition of camel milk

Country	TS %	Fat %	SNF %	Protein %	Lactose %	Ash %	Water %	Specific gravity	Reference
Egypt	11.16	2.00- 4.00	-	-	3.90- ±0.42	0.76 ±0.009	84.98 ±0.11	-	Shalash (1980)
India	13.57	3.78	9.99	3.95	4.88	0.95	86.48	-	Dhri and Joshi (1961)
	9.75	3.20	6.55	2.68	3.20	0.60	-	1.026	Desai et al. (1982)
	12.39- 14.30	3.5- 5.5	8.5- 10.1	2.0- 5.5	-	-	-	1.030	Khanna (1986 ^b)
BIKANERI} KACHCHHI}	-	2.8	-	2.68	4.99	-	-	-	Anonymous (1990)
BIKANERI	11.50	2.20	-	2.77	5.62	0.69	-	-	Khanna et al. (1990 ^b)
	9.85- 10.81	2.43- 3.38	7.22- 7.28	-	-	-	-	-	Anonymous (1992)
	-	2.90- 5.50	8.90- 14.30	2.50- 4.50	2.90- 5.80	0.35- 0.95	86.30- 88.50	1.0300	Khanna and Rai (1993)
TURKMAN Sahara (Iran)	12.38	4.19	-	2.90	4.52	0.77	-	1.031	Karim and Gooklani (1987)
Pakistan	-	2.90	-	3.67	5.78	0.66	86.94	-	Yasin and Vahid (1957)
Saudi Arabia	11.07	3.60	-	3.00	4.40	0.80	-	-	Sawya et al. (1984)

2.7 CAMEL HAIR AND UTILITY

The camel hairs are used for preparing ropes, blankets, carriage bags, rough cloth, clothes for animal cover, floor rugs etc. They possess good insulating property.

The annual availability of camel hair in India is to the extent of approximately 0.8 million kg. The fineness of camel fibres ranges from 26 to 38 microns and its length varies from 51 to 67 mm (Khanna and Rai, 1991).

Studies on birth coat of Bikaneri camel (Swaroop and Chowdhary, 1984) showed that fibres of shoulder region were significantly longer than those of mid-side region. The fibres of female camels were significantly finer than those of the males.

Chowdhary (1986^a) reported that the birth coat had finer hair than those of adult coat in the Bikaneri camels. The camels carried a mixed coat comprising of very coarse hair and of comparatively finer fibres known as 'Camel hair wool'. He recorded an average hair production 600 to 712 g in male and 650 to 837 g in female camel.

Patani (1987) working at Central Sheep and Wool Research Institute, Avikanagar stated that camel hair is a special type of hair fibre having many desirable properties. As compared to wool, camel hair is slightly stronger. Since camel lose outer and under-coats simultaneously during shedding time, it is difficult to separate the hair from the camel wool fibre. In camel fibre shedding takes place (if not shorn) during March. Therefore,

shearing takes place once a year in spring, usually around the time of the Holi festival (February/March). The young camels upto one year of age have fine birth coat termed as 'woolly'. As the camel ages both the colour and diameter change. The hairs are longer at hump, neck, shoulder and tail region of camel. The hair growth is lower during summer than that during winter.

Khanna *et al.* (1990^b) from National Research Centre on Camel, Bikaner reported that hair production was high in animals upto 2 years of age than that in adults. Kachchhi camel annually yielded significantly higher hair (1085.29 ± 32.77 g) as compared to Bikaneri and Jaisalmeri (approximately 800 g). This observation confirmed the report of Burgemister (1978) stating that camel hair production is higher in juvenile than that in adult Bactrian camels.

Average annual hair production in Indian breeds of camels kept at National Research Centre on Camel, Bikaner (Anonymous, 1992) is given below. The Bikaneri camels had the highest annual hair production followed by the Kachchhi camels.

Table 2.7.1 Annual hair production (kg per head)

Age group	Bikaneri	Jaisalmeri	Kachchhi
0 - 1 year	1.062 ± 0.14	0.725 ± 0.07	1.04 ± 0.08
1 - 2 year	0.969 ± 0.07	0.675 ± 0.07	0.733 ± 0.08
Adult	1.09 ± 0.04	0.866 ± 0.00	0.93 ± 0.05

Singh (1966) has given details of traditional shearing practice in camels. The camels are generally clipped in the spring season. Generally hand shears are used for clipping. The shearing is done as close to the skin as possible and without injuring the animal. In working camels, the seat of the saddle is not clipped which helps in preventing of galls. This hair will prevent galls. The calves are not clipped till the monsoon breaks. This gives them protection against the hot winds. The animals are covered with a blanket when the nights are cold. As a measure of precaution against the attack of skin parasite, teramira or sarson oil is smeared all over the body of the camel after it has been clipped. This is necessary especially when the winter coat is heavy. After applying oil, the animal are kept in the shade, as exposure to the sun may sometimes cause blistering.

2.8 MODEL CHROMOSOMAL PROFILE

Khanna (1987) reported that 74 somatic chromosome were found in Bikaneri breed. One pair of metacentric, 5 pairs of sub-metacentric and 30 pairs of acrocentric chromosomes were observed. The X chromosome was seen to be large metacentric while Y was observed to be small acrocentric.

Vijh *et al.* (1989) have studied chromosome number in Kachchhi camel. The diploid chromosomes number were found to be 74 which included 6 pairs of acrocentric autosomes, 25 pairs of sub-acrocentric autosomes and 5 pairs of sub-metacentric autosomes. The X chromosome was sub-metacentric and Y chromosome was found to be acrocentric.

2.9 TRADITIONAL CAMEL MANAGEMENT PRACTICES

Traditionally camel production in India is a livelihood for many races of nomadic pastoralists. Camels have not only multifacet utility for them, but are the most suited companion for them in the arid zone. Similarly traditional pastoralists have taken keen interest in development of camels as well as camel management practices. Sometimes scientists blame their managerial practices as irrational, inefficient and ecologically destructive. One of the most frequent complaints is that they keep large number of unproductive animals. Although, they builtup their herds during the period of plenty, these extra animals serves as a buffer against heavy losses during drought and therefore work as an insurance for them. It has also been appreciated that many pastoral races have developed their own systems for preservation of pastoral resources. However, there can always be scope for improvement in camel managerial practices with increased scientific knowledge on this. Therefore, available literature is reviewed here to understand traditional managerial practices which are evolved by experiences of many generations and have proved sustainable in the odds of arid zone camel production.

2.9.1 Traditional camel breeders

Khanna (1990) has presented history and development of camels in India from proto-historic to the present times. Traditionally camel breeding is undertaken by villagers in India, who keep camels in small to very large herds of about 200 to 250

heads. A tribe known for specialization in camel breeding and management is 'Raikas' in Rajasthan. Few Mohammedan camel herds men are also located in Rajasthan.

In an extensive field survey and review of literature (Kohler-Rollefson, 1982), it was indicated that Rajputs and 'Raikas' were only two castes breeding and owning camels in Western India. The Rajputs composed of the ruling elite of Rajahs and Maharajahs of various states of Rajputana. The Rajputs employed members of a specialised caste, the 'Raikas', to look after their camel herds. Many of 'Raikas' continued their camel breeding and today most large camel herd are with them. Currently with increased importance of camel as a draught animal, ownership of camels is wide spread among the rural population of Western Rajasthan. Members of agricultural castes with some land holdings such as 'Jats' and 'Bishnois' are increasingly taking up camel breeding, however, they keep small herds which are well fed on agricultural by-products.

A survey in Kachchh district of Gujarat State (Anonymous, 1992) revealed that 80 per cent camel population in the district is maintained by 'Rabaries'. The camels are kept in small herds (5-15 camels) to large herds (80-150 camels).

Kohler-Rollefson and Rathore (1995) observed that only 'Rabari' community settled in Madhya Pradesh own Malvi camel herds. The 'Rabaries', breeding the Malvi camels, have some association with the members of same caste of Rajasthan and Gujarat.

2.9.2 Camel pastoralism

The system of camel management vary to a considerable extent depending on the ecological setting and the extent of agricultural development in the area. It is also dependent on the type of products desired from camels.

Study on camel pastoralism in Rajasthan (Anonymous, 1991) came out with interesting observations. There are certain principles followed by the 'Raikas', the camel breeders in Rajasthan. They do not kill camels or eat camel meat. They do not sell camel milk or process camel milk. They also do not sell camel wool and even dead animals. Contrary to this, the Mohammedan and Jat camel breeders have no qualms about selling camel wool, hides, bones etc. The prime purpose of camel breeding is for sale of draught animals, which are in high demand for transport and ploughing.

In the agriculturally deficient areas of Bikaner, camel herds roam unsupervised for most or larger parts of the year. The camels come back to the village on their own to drink water. Everybody within a radius of 50 km knows the animals by their brand mark. Camels are collected only during the rainy season to prevent them from inflicting damage to the Kharif crop. In scarcity, the herds are taken to far areas in search of feed for few months. Migration is a common feature for pastoralists of Pali area where crop cultivation is much more intensive. The herds from Marwar have to migrate far to the east upto the border of Madhya Pradesh for getting feed with the increasing intensity

of agriculture, the camel breeders are forced to migrate long distances. The migratory herds of Bikaner are usually larger in size as seen from the table given below.

Table 2.9.1 Size distribution of Raika camel herds

Herd size	Bikaner	Pali
1-20	-	1
21-50	-	3
51-100	7	1
101-150	6	21
151-200	1	-
201-400	2	-
N	16	26

In Kachchh district also migration of camels to distant places is a common practice during the lean months (Anonymous, 1992). Grazing in summer and winter period is done for about 14-16 hours and 10-12 hours daily, respectively. The herd size varies from small (5-15 camels) to larger (80-150 camels) herds. A few herds having more than 500 camels are also available.

According to Kohler-Rollefson (1993) large scale camel breeding is virtually restricted to pastoral nomads in Western India. There are specialized caste of camel breeders in India. They breed camels for production of surplus draught animals. Camels pastoralists keep mental records of their animals' ancestry. The 'Raika' community of Western Rajasthan recall their

camels' ancestors for eight generations and pass on this knowledge to next generation. The camel breeders do not usually sell or buy female camels. Consequently, breeding stock is circulated only within a society by means of different types of social transactions viz., gifts at birth or dowry at wedding. The Raikas looked after the royal camel breeding herds owned by Maharajahs in Rajasthan. The author emphasized to document and preserve the camel breeds, unique genetic resources of arid zones, because there is continuous erosion of many social structures and circumstances those have created these breeds. The ownership of camels is now getting widespread among the rural population and not remaining restricted to a particular caste or a occupation. While describing social and historical perspective of Indian camel breeds (Kohler-Rollefson, 1992) stated that in Kachchh camel breeding was not a matter of royal patronage. It was practiced by Rajputs, Rabaris, Sindhis and Bharavads. The Rabaris sometimes subsisted for weeks on milk of Kachchhi camels. It was also said that the camel milk was even marketed.

Kohler-Rollefson (1994) extensively studied camel pastoralism in Jordan, Sudan and India. She regarded camel husbandry as a model for sustainable and ecologically responsible land use for many arid zones of the tropical world, those are frequently prone to droughts and famines. The crucial feature of camel pastoralism is always mobility and all pastoralists make sure that camels range over wide areas. Their camels are kept under conditions that resemble those of ranching system, with the distinction that they rely on communal pasture. Camels are

allowed to range freely round the year around a watering spots. They are able to trace the movements of their animals from the foot prints of each individual they own. Sometime the camel herd is split up into milking animals which are kept close to the main settlements where women and children reside, while the rest of the herd is watched over by young males in satellite camps. The pastoralists have astonishing knowledge and familiarity of local vegetation and plants for their nutritive and medicinal values.

Kohler-Rollefson and Rathore (1995) visited breeding tract of Malvi camels, a dual purpose camel breed known for work and milk. They observed that the breeding Malvi camels were kept exclusively under extensive management systems on natural grazing only. Herd size ranged between 50-100 camels and composed mostly of female camels. Each herd consisted only one male camel for reproduction. They further investigated that Malvi breeding herds migrated between three locations. Between April and June they stayed in the vicinity of their home villages in Mandsaur district (Madhya Pradesh). With the onset of the rainy season in the beginning of July, they migrated to Rajasthan in the area around Kota and Jhalawar-Patan. In september, they move onto the vicinity of cities in Madhya Pradesh including Bhopal, Indore and Ujjain to take advantage of opportunities for selling camel milk.

2.9.3 Housing facilities

According to Nanda (1985) the camel shed should be simple with a shed for shelter against sun, rain and droughts. However, adequate provision of space, sanitation and comfort are

necessary. The camel shed should be constructed on an elevated plot of land which may provide natural drainage for rain water. A three walled enclosure, open on one side, and with a roof made of tiles or a thatch would serve the purpose very well. Zinc sheet roof should be avoided. The walls may be rising up about 1 1/2 to 2 ft below the roof to provide adequate ventilation. The open side should not face the direction of prevailing winds. The camel shed should have a manger 3 to 3 1/2 ft high from the ground. The plan of a camel shed for ten camels, given by the author, is depicted in Fig.2.3.

Chowdhary (1986b) suggested that the sand is the best bedding material in the desert. Each camel needs 9 x 12 feet (2.7 x 3.6 m) area for housing with water trough of 3 x 3 x 2 feet (0.9 x 0.9 x 0.6 m) and feeding trough of 4.5 x 3 x 2 feet (0.35 x 0.9 x 0.6 m). Camel house should be open in the west. The design for a 12 camels, stable given by the author, is presented in Fig.2.4.

The camels of Central and Southern Kenya were herded during the day and penned at night in open enclosures on the ranches (Evans and Powys, 1980 and Wilson, 1986).

Prajapati (1993) observed that rular draught camels including male and females of Mehsana and Sabarkantha district were kept tied in an open yard round the year.

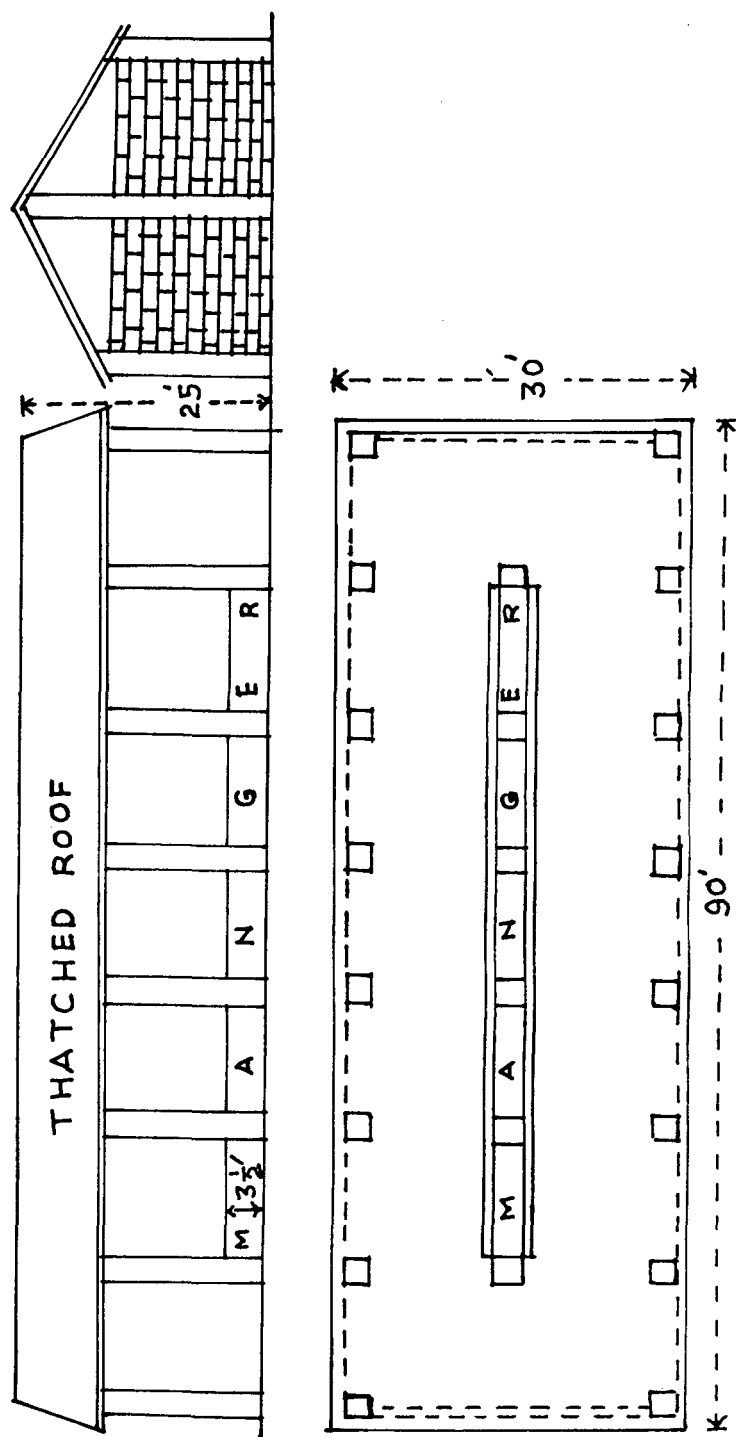
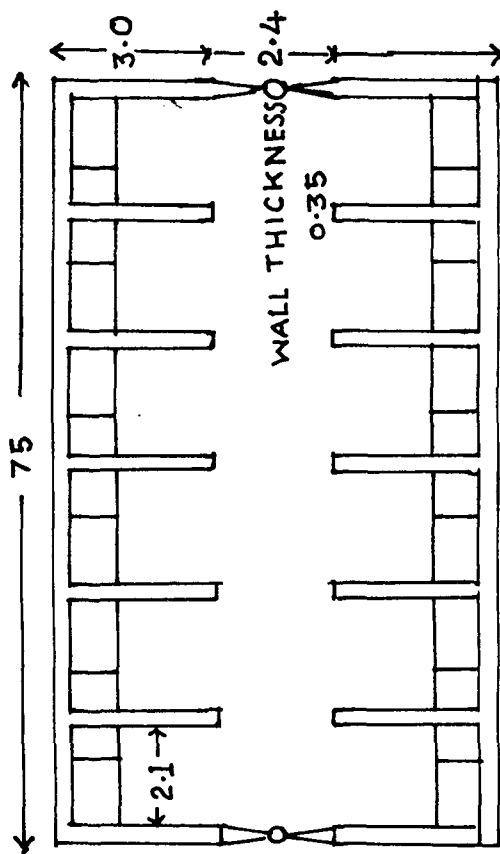


Figure 2.3: Plan of a camel shed for ten camels (dimensions are in feet)

GROUND PLAN



ELEVATION

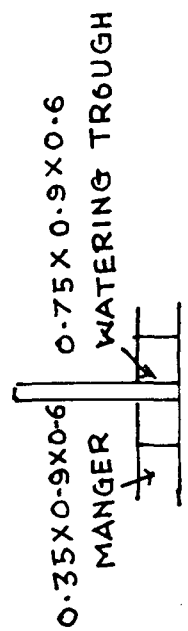
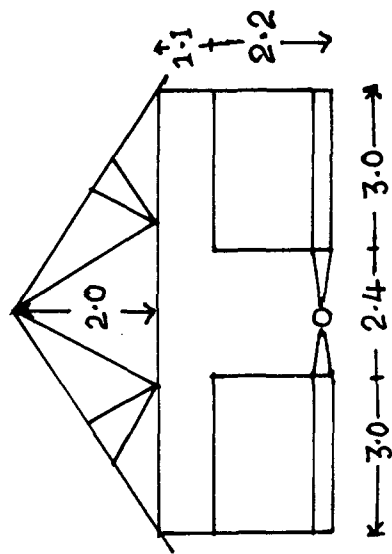


Figure 2.4: Plan of stables for housing twelve camels (dimensions are in meters).

2.9.4 Feeding and watering management

2.9.4.1 Feeding

Camel is a herbivorous animal, and prefers to browse rather than graze on many thorny and extremely spiny plants found in its native locality.

Matharu (1966) from U.P. College of Veterinary Science and Animal Husbandry, Mathura observed that camel prefers to browse rather than graze. The leaves of neem, pipal and twigs and pods of babul are said to be the favourite loppings for camel. He found necessity of hand feeding with grains to supplement grazing and browsing in seasons of scarcity or when sufficient time can not be spared for grazing. He noted that camel can eat all sorts of feeds unsuitable for other herbivora and live on leaves of hard thorny plants including acacia and cactus. Being a ruminant camel needs minimum six hours for foraging. The working camels are allowed to graze in the morning and late afternoon, and are fed with grains once a day in the evenings followed by some fodder, if necessary at night.

Anonymous (1970) studied pasture grasses in the Banni area of Kachchh. Sample of individual grasses were collected from the sweet and saline regions of the area. The composition of the grasses predominant in the saline region is given in table 2.9.2.

The results indicated that among all the grasses, Oin was found superior as it was having 12.47 per cent crude protein and least fibre content (18.32 per cent). All other grasses were

having only 2-6 per cent protein and crude fibre content as high as 30-38 per cent. Moreover, Oin was also quite rich in calcium, containing 1.23 per cent as against 0.24 to 0.57 per cent in other grasses.

Table 2.9.2 Composition of grasses from the saline region of Banni area in Kachchh

	Dabhado	Dinai	Khivai	Oin	Samo	Lamp	Shial punchh	Khario	Fuldi
C.protein	4.49	2.60	4.50	12.47	5.82	2.56	5.07	5.06	5.83
E.Extract	2.16	1.74	1.81	3.06	1.78	1.35	2.36	2.22	2.18
NFE	49.86	47.76	49.16	41.42	45.28	52.10	48.61	47.21	48.38
C.fibre	31.36	37.67	34.39	16.32	32.10	36.23	31.41	29.74	34.27
Ash	12.10	10.27	10.21	26.73	15.04	7.76	12.55	15.77	9.34
Silica	5.62	6.65	5.11	5.49	4.58	4.78	4.12	7.10	5.41
Phosphorus	0.20	0.16	0.21	0.11	0.22	0.17	0.20	0.17	0.21
Calcium	0.34	0.24	0.36	1.23	0.57	0.46	0.30	0.47	0.31

The composition of grasses from sweet region was almost similar to that of the same species of grasses from the saline region.

Rao et al.(1970) working at National Dairy Research Institute, Karnal reported that feeding of camel is confined to browsing and grazing. On an average it consumes 25 to 40 kg of good fodder. In addition to this heavy working camel is given 2.5 kg of concentrate and straw daily. Salt may be mixed with the concentrate.

Dorman (1984) reviewed information on some aspects of camel nutrition and concluded that the dromedary is predominantly a browser except in Somalia and parts of North East Ethiopia where grass is the feed of choice. The dromedary generally forage on wide foliage of trees, shrubs and ground herbage including grasses. When browsing, it takes a few mouthfuls from one tree or bush and then moves on the next covering a large number of different herbages spread over larger range. Usually browsing is allowed for upto 8 hours daily. Nomads ensure that their animals browse/graze the right vegetation in the right season avoiding toxic plants. The author pointed out that the camels are not reported responsible for any substantial degradation of range land.

ICAR (1985) has given guidelines for providing nutrients to camels during different physiological phases. Accordingly the nutrients needed for maintenance of camel are presented in Table 2.9.3.

Table 2.9.3 Daily nutrient requirement for maintenance of camels

Live weight (kg)	DM (kg)	DCP (g)	TDN (g)	Ca (g)	P (g)
500	12.0	500	5,500	300	100
550	13.0	525	6,000	225	120
600	14.0	550	6,500	250	150
650	15.0	600	7,000	250	150
750	16.5	650	7,500	250	150

The data given in Table 2.9.3 provides guidelines on dry matter, DCP, TDN, Calcium and Phosphorus needs at different body weights. The critical study of the same indicates that any ration containing approximately 4 per cent DCP, 45 per cent TDN, 2 per cent Calcium and 1 per cent Phosphorus could meet the requirement of adult camel, if fed as per the dry feed requirement per day.

Nutrients needed during growth stage are presented in Table 2.9.4. It gives recommendation to support the growth rate of 100 g/day.

Table 2.9.4 Daily nutrient requirement of growing camels
(Growth rate 100 g per day)

Live weight (kg)	DM (kg)	DCP (g)	TDN (g)	Ca (g)	P (g)
200	5.0	250	2,000	80	30
250	6.0	325	2,500	100	35
300	7.5	350	3,000	120	50
350	9.0	470	3,800	145	60
400	10.0	600	4,700	185	80
450	10.5	650	5,000	200	100

The nutrient needs for reproduction, lactation and work need are not given in tabular form. However, it is recommended that the animals in advance stage of pregnancy, lactation and those put to 6-8 hours of work daily should be provided with 25 per cent more nutrients to meet the nutrient demand of the growing foetus, milk synthesis and work.

Chowdhary (1986^b) in his field experiences with camels in Rajasthan also noticed that camels utilize natural vegetation very rationally in the desert without damaging them. It is in the habit of the camels that they do not overgraze and move quickly from one plant to another. Even in stall-fed condition, they move from one place to another. Camels get feed from trees and bushes. They are fed on grasses only in rainy season for 1 to 2 months in India. They eat such species of plants that are high in moisture like Khejri (*Prosopis cineraria*), Pala (*Zizyphus nummularia*), Phog (*Calligonum polygonoides*) during summer, and plants high in minerals like Ker (*Capparis decidua*) and Sewen (*Lasiurus sindicus*) during rainy season.

Camels when let loose for grazing normally follow an experienced, strong and healthy female as she knows or guesses correctly the direction of available feed. The younger camels follow the leader who is tall and has a trick to catch the high top branches and bring them downward by giving a jerk so that the others can apprehend the foliage.

Chowdhary (1986^b) further recorded that common top feeds for camels in the desert are Bordi (*Zizyphus nummularia*), Khejri (*Prosopis cineraria*), Parkinsonia (*Parkinsonia aculeata*), Phog (*Calligonum polygonoides*), Khimp (*Leptadenia spartium*), Ker (*Capparis decidua*), Rhohida (*Tecomella undulata*), Jal (*Salvadora oleoides*), Pilojal (*Salvadora persica*), Kumat (*Acacia senegal*), Ardu (*Ailanthus excelsa*), Murali (*Mimosa hamata*), Shissum (*Dalibergia sissoo*), Kikar or Babool (*Acacia nilotica indica*),

Israeli Babool (*Acacia tortolis*), Ark (*Calotropies procera*), Murali (*Lycium barbarum*), Farash (*Tamarix articulava*), Pradeshi babool (*Prosopis juliflora*), Sares (*Albizzia lebbeck*), Neem (*Azadirachta indica*). The by-products of Moth chara (leaves of *Phaseolus aconitifolius*), Guar phalgati (the pod-coverings of gum (*Cyamopsis tetragonoloba*), Guar guna (the branches) gram gotar, straw of bajara and wheat and pala (*Zizyphus nummularia*).

Rathore (1986) has given exhaustive list of vines, shrub, bushes and trees growing in the deserts of India with their distinctive characters. He writes that in the natural semi-wild state, where herds of breeding camels are kept the camels depend entirely on browsing and grazing without feeding any extra fodder. It is not common to give salt to camels. The camels loose body condition during winter due to scanty feed.

National Research Centre on Camel, Bikaner took up a Programme on evaluation of feed resources for camels (Anonymous, 1991), *Guar phalgati* was found suitable feed for maintenance purpose during normal and drought periods. Though the feed was found moderately palatable, it contained 5.13 per cent DCP and 69.73 per cent TDN.

In a study (Anonymous, 1992) on traditional camel management in Kachchh district of Gujarat, it was noticed that the most prevalent vegetations in the area were Luna grass, Mothia and fodder trees (*Acacia*, Khari and *Prosopis juliflora*). Migration of camels to distant places during lean months was observed as a common practice. The camels were grazed every day

for 14 to 16 hours during summer and for 10-12 hours during winter.

In a survey traditional camel management in two villages, namely Gadwala and Hussansar of Bikaner district, it was reported that grazing was practiced in both the villages during November to June, although draft camels were maintained as stall-fed animals. Leaves of Bordi (*Zizyphus mauritina*), Khejri (*Prosopis cineraria*), Jhal (*Salvadora oleoides*), Phog (*Cabligonum polygonoides*), and crop residue of Moth (*Phaseolus aconitifolius*) and Mung (*Vigna radiata*) were the staple feeds of camels (Anonymous, 1992).

Dromedary is selective in browsing bushes and trees, and selecting feeds which are highly digestible and have a high moisture content (Schwartz, 1992). They make better use of a protein poor diets than true ruminants, but considerably poorer use of any diet poor in energy and rich in crude fibre than other ruminants (especially Zebus). If dromedaries are to be fed on fibrous feeds they must be supplemented with energetic concentrate. The author has also compared (Table 2.9.5) the dromedary with other ruminants on arid and semi-arid pastures of East Africa and Sahel and concluded that the dromedary is distinctly superior in utilizing variety of fodder and also in lower water requirement. They, therefore, frequently migrate into the regions in which the grass cover has been destroyed by overgrazing with bovines and sheep, and offer fodder for this species.

Table 2.9.5 Classification of different species of grazing animals by some characteristics of feed and water intake

Species	Preferred fodder plants	Selectivity type	No. of fodder used (%) ¹	Reach (meters above ground)	Watering intervals (days)
Dromedary	Bushes, trees	Concentrate	170	3.5	10-14
Goat	Bushes, herbs	Concentrate	184	1.6	3-4
Sheep	Herbs, grasses	Intermediate	142	1.2	3-4
Bovines	Grasses	Quantity	100	1.5	2

1 No. of fodder plant species taken by bovines on a thorn-bush Savannah = 100 per cent.

Prajapati (1993) conducted survey on feeding practices for camels in rural areas of Mehsana and Sabarkantha district and observed that the rural camels kept for breeding purpose were fed solely by browsing and grazing without any hand feeding of extra fodder. He also surveyed for the availability of common bushes, shrubs, vines and grasses for camels in this area and listed them as under.

Vines:

Kakoda (*Momordica dioica*), Gokharu (*Tribulus terrestris*), Indrayan (*Citrullus colocynthis*), Dodi (*Leptadenia reticulata*), Chanothi (*Abrus precatorius*), Giloda (*Coccinia grandis*).

Shrubs, bushes and trees:

Khimp (*Leptadenia spartism*), Neem, Khumata (*Acacia senegal*), Bordi (*Zizyphus mauritiana*), Gorusamli (*Pithecellium dulce*), Khijado (*Prosopis cineraria*), Lakha lumi (*Portulaca oleracea*), Pardesi khajedi (*Prosopis juliflora*), Pilu (*Salvadora persica*), Pala (*Zizyphus nummularia*), Babool (*Acacia arabica*), Rohido (*Ficus racemosa*), Ker (*Capparis aphylla*), Nilgri (*Eucalyptus tereticornis*), Kanthar (*Capparis sepiaria*), Peepal (*Ficus religiosa*), Mango (*Mangifera indica*), Gajjar or ratadiya (*Daucus carota*).

2.9.4.2 Watering of camels

Camel can maintain itself on a limited supply of water for a longer period than any other animal of the desert. The quantity of water required by camel varies with the feeding habit, age, breed, ambient temperature (climate), habitat, work load, physiological condition and management (Leupolds, 1968; Matharu, 1966; Dorman, 1984 and Chowdhary, 1986^b).

Matharu (1966) reported that camel in India drinks 18 to 36 L of water, if watered daily. It may drink more about 85 L a day after being without water for a considerable period. This was confirmed by Rao *et al.* (1970) who recorded daily consumption of about 14 to 36 L depending upon type of fodder fed to camel.

Camel can tolerate 5 per cent salt in drinking water as compared to cattle which can tolerate 1 per cent, sheep upto 1.5 per cent and goat upto 2 per cent salt in water (Khanna, 1986^a).

Rathore (1986) suggested watering management for Indian camels. In desert areas where water is not easily available and the camels are required to go on long journeys, they may be watered on alternate days or even third or fourth day so that they can get accustomed to go without water for longer and longer periods. In plains or in the hills, where water is plenty in ponds and rivers, they are watered twice a day i.e. morning and evening. In summer, camels should be watered in the morning hours when water is cool and fresh. In winter, they should be watered at mid-day when water gets warmed. The author also advised that camel should be watered at least one hour before the march or starting of work.

In a study on growth performance of camel calves (1.5 to 2.0 years) by replacing 30 per cent of DM by fomet green barley with *ad libitum* intake of dry Moth chara during winter season, it was concluded that daily water intake from feed and free source was higher in animals on daily watering schedule than those on weekly watering schedules (Anonymous, 1991). The weekly watering schedule was not found optimum for the growing camels on the feeding regimes.

Traditionally camels in the Bikaner district of Rajasthan and in the Kachchh district of Gujarat are watered twice a week (Anonymous, 1992).

Schwartz (1992) pointed out that water requirement was lower in dromedaries as compared to that by Zebus in arid and semi-arid ranches in Kenya, camel could very well tolerate long

watering interval hence they could utilize pasture lying upto 100 km from watering places.

In villages of Mehsana and Sabarkantha district of Gujarat State, rural camel were watered twice a day (Prajapati, 1993).

2.9.5 Care and management of camels

2.9.5.1 Suckling camel calves

Better care and management of suckling camel calves is important for their better survival and growth.

Rathore (1986) described care of calf after birth. The Navel string usually gets ruptured when the she-camel stand up after parturition. If there is bleeding from the navel, a ligature should be used to stop bleeding. He advised to apply some antiseptic lotion to the navel cord and to clean the newborn calf with clean cloth for removing mucous from the nostrils. The newborn takes about 2 to 4 hours to stand on its legs. The calf is unsteady on its legs and takes about a week to walk properly. Therefore, camel owners keep the calf at their camp when she-camel is sent for grazing, till it is quite fit to walk with the herd. When the camel is shifted, the young calf is tied on to the back of the she-camel to be carried with her.

Chowdhary (1986b) recorded *ad libitum* feeding of colostrum to camel calves soon after birth. Orphan calves may be fed colostrum from other camels by bottle. In a herd of camels one or two she-camel are found to be docile which may be used as foster mother.

Traditionally camel keepers in Bikaner district allowed camel calves to suckle milk from their dams freely (Anonymous, 1992).

The calves were generally allowed to suck twice a day. Under ranch conditions of Kenya and Horns of Africa, camel calves were allowed to suckle 2 teats while 2 teats were milked (Field, 1980 and Hartely, 1980).

The calf starts to grazing at four to six weeks of age (Singh, 1966 and Prajapati, 1993).

Malvi camel breeders were keeping calves with their mother and allowed to suckle milk except during night time (Kohler-Rollefson and Rathore, 1995).

There is no published information on optimum age for weaning camel calves. However, Singh (1966) and Rao *et al.* (1970) indicated that traditionally the calves are allowed to suckle their dams upto 12 to 15 months (full lactation) in India. Chowdhary (1986b) opined that the calves may be weaned at the age of 8-10 months. The calves may be kept away from dam in separate pen for 2-3 weeks, to facilitate weaning. The weaned calves may be fed good quality Moth chara and Moth Dal mixed with salt each day. Weaning is normally done in the first week of October. Each camel calf should be drenched with anthelmentic at this time. A watch may be kept on the weaned calves for few days.

2.9.5.2 Growing camels

A well trained camel is a docile gentle and obedient animal. A small boy of 8 to 10 years mastering a huge animal like an adult camel is quite an amazing, but a common sight in villages. A trained camel is as comparable as with a trained horse or bullock for getting a work done (Rathore, 1986). The most suitable age for breaking camels is between 2 and 3 years. The methods of breaking and their implementation may depend on the purpose for which the camel is to be used.

A young camel can be broken for baggage at any stage after two years and for riding when he is of three years (Singh, 1966). To start with allow the young animal to follow the adult animals. Thus it gets used to the tract. He advised to pierce the nostril of a young animal for nose-peg at least a month before you intend to start breaking it. While breaking tie a rope around its neck and connect this rope with that around the neck of a quiet but strong animal. The younger trainee will thus follow the older one. After some training tie the neck rope of young trainee to the tail of the older one in the line of march.

Nanda (1965) gave important clues in handling camels. A leading rope is a common contrivance for handling a camel. The rope is attached to a nose string which in turn is tied to a nose-peg. A nose-peg with a nose-string should always be provided even if the animal has a head collar. Care should be taken to avoid rough handling of the rope attached with the string, otherwise may lead to injury and discomfort. The nose-peg is a

wooden piece of 2 1/2 inches length and 1 1/2 inches in diameter. It is passed through a hole made in one or both the nostrils. Sometimes a metal ring is used in place of wooden nose-peg. The reason for tying the rope with the string attached to the nose-peg is to prevent tearing of nostril, as the string breaks on heavy pulling when camel suddenly slips or stumbles.

The art of breaking and handling of camel is learnt by experience and close association with the animal. As with other work animals, camels should be held boldly and firmly even otherwise they are docile. The handling of camel is usually troublesome during the rutting season and it is advisable to keep the male separate from the females during this season.

Growing female camels were solely dependent on browsing and grazing in Mehsana and Sabarkantha district of Gujarat State (Prajapati, 1993).

2.9.5.3 Breeding camels

Chowdhary (1986^b) and Rathore (1986) described mating in camels. The copulation take place with the female in the sitting position and the male camel squatting on her. The first step in squatting is flexing the joints of hind limbs by male camel and holding the female with fore legs. Both the male and the female faces the same direction. In the female, knee should be fixed with strong rope (Goda bandani) and the male is then allowed breeding preferably in a calm and quite environment. The sexual act takes about 15 to 25 minutes. Old and experienced males

should be used on inexperienced young females as they will be able to manage and hold the females between their knees. Young inexperienced male camels should be used on old experienced females. Sometimes erection of penis occurs simultaneously with kneeling due to the less cooperative movement of the female (due to young age). Hence male find it difficult to penetrate. At this stage the penis may be directed towards the vulva with a clean sterile muslin cloth. Generally, no help is required at the time of mating in experienced camels.

The pregnant camel should be fed good quality fodder and concentrates at the rate of 14 kg and 3 kg per day, respectively from 5 months before parturition. They should be looked after by a vigilant camel attendant to avoid fight during feeding (Chowdhary, 1986^b).

In Mehsana and Sabarkantha district, some owner fed their camels after calving with flour of bajara or wheat and gur (molasses) for 10 to 15 days in order to improve the milk production and health of animals (Prajapati, 1993).

Male camel is very jealous of another male during rutt season. They also fight fiercely if put together. Care should be taken to avoid this situation. Do not beat a camel during breeding season, only show the stick (Chowdhary, 1986^b).

Camel pastoralist in Rajasthan gave special attention in breeding management of stud camels (Anonymous, 1992). The Raikas were found experienced and thoughtful camel breeders by any

standards. The selection of a stud male was considered the most important by them and was handled with utmost discrimination. The selection criteria for male camels were pedigree, mother's and sister's performance (especially in terms of milk yield), confirmation, colour and facial expression. The stud males were exchanged regularly at four years interval with neighbouring herd owners, usually on a friendship basis and without cash being involved in transaction. The aim behind exchange of male was to prevent inbreeding.

Traditional camel breeders in the Kachchh district normally used one stud in a single herd and they replaced the stud camel after 3 to 4 years (Anonymous, 1992).

Schwartz (1992) in his study on two commercial ranches in Kenya noticed that traditional breeding measures were limited to the selection, at the age of four to five years, of breeding stud camels. Normally selection criteria were body size and mild temperament. Occasionally the milking performance of the bull's mother was considered, though not with regard to the absolute milk performance level but more with regard with the persistence of milking performance in lean period and years of drought.

Kohler-Rollefson (1993) reported that the selection of the breeding male in Somalia was based on appearance, behaviour, physical strength and the characteristics of his ancestors viz., milk production, colour and resistance.

Matharu (1966) and Singh (1966) reported that during rutting season, camels are liable to fall off in conditions.

Therefore, Chowdhary (1986b) suggested that the males should be kept separate from the herd and be fed in the stall. During this period, they should be given each day about 1.5 L sesame or groundnut oil mixed in 1 kg of jaggery as a feed supplement.

Traditionally stud camels are fed ghee, oil, eggs, boiled guar etc. as energy supplement during breeding season in the Kachchh (Anonymous, 1992). This type of practice was tested with scientific feeding alternatives by Jakhmola and Roy (1995) at NRCC, Bikaner. The study indicated that studs need additional source of energy to meet their maintenance requirement during breeding season which could be done through suitable supplement like crushed barley.

2.9.6 Camel health

Sound health is important for better productivity in camels. Camels have several common health problems viz., external and internal parasites including trypanosomiasis, infections of respiratory and digestive system. Timely prevention and control measures may reduce heavy loss. High calf mortality is known to be the major constraint in building up the camel herd.

Chowdhary (1986^a) studied the mortality pattern in 1,008 Bikaneri calves born at the Camel Research Centre, Jorbeer, Bikaner. Overall mortality percentage in the calves upto one year of age was 14.88 per cent. The male calves had higher mortality rate than the female calves. Mortality among 1,207 camels beyond one year of age was 4.05 per cent among males and 9.76 per cent among females. The highest mortality was recorded during the

first month of age, more so in males. Major causes of death were broncho-pneumonia and gastro-enteritis.

Tandon *et al.* (1988^a) collected data on mortality in Bikaneri camels kept at the National Research Centre on Camels, Bikaner. The mortality risk was highest in animals less than 3 months of age and lowest in adults. The mortality rate was higher in males than in females upto 3 years of age. The overall risk of mortality for the camel population was high during May to July (the intense summer), especially in calves upto 3 months of age. For camels between 3 months to 3 years of age, the high risk months were March to July. Higher mortality rate upto three months of age was also recorded by Khanna *et al.* (1990^b) in the camels.

Camel calf mortality in 1225 camel calves born during 1961-90 and reared under farm bred semi-intensive management system at the camel breeding farm, Bikaner indicated that mortality was 11.39 per cent upto 6 months of age and it was 2.79 per cent in calves aged 6 to 12 months. Sex and period had no statistically significant effect on the calf mortality in both the age groups.

The major causes of death in the calves of both the age group were diseases of digestive system and respiratory system. Highest risk of mortality was during the winter months in the calves upto 6 months age which was incidentally breeding and calving season of camels in India. Standard death rate in Bikaneri, Kachchhi, Jaisalmeri, and Arab x Bikaneri crossbreds kept at NRCC, Bikaner was 5.12, 9.81, 1.51 and 6.29 per cent,

respectively during 1981-82 (Anonymous, 1992). The mortality was highest in younger groups (0-3 months) followed by adults (above 3 years). The mortality rate was slightly higher in males as compared to females.

Studies of Schwartz (1992) revealed higher mortality rate for camel calves under traditional nomadic production system (55 per cent) than those under ranch conditions (6.2 per cent) in Kenya. The mortality was higher in the males than in the females. The major causes of calf mortality were malnutrition, pneumonia, intestinal parasites and ticks infestation.

Prajapati (1993) in his field survey in Mehsana and Sabarkantha district on 269 rural camels, observed overall mortality of 10.78 per cent with calf mortality of 62.07 per cent. Diarrhoea (28.13 per cent) and pneumonia (10.79 per cent) were the major causes of calf mortality.

The Raikas were having extremely detailed knowledge of camel diseases and affections (Anonymous, 1991). They employed indigenous systems of treatment in the disease conditions depending upon individual experiences as well as resources available on hand. Mange and Trypanosomiasis were the most economically significant diseases observed in the camels of Bikaner and Pali districts of Rajasthan. Chowdhary (1986b) and Kohler-Rollefson (1994) also gave Mange and Trypanosomiasis as major health problems in camels of pastoralists. The later worker also came across indigenous system of treatment followed by the pastoralists.

CHAPTER - III

MATERIALS AND METHODS

3.1 LOCATION

Present study was undertaken to study important breed characteristics of Kachchhi camels and traditional management practices followed by the camel breeders in Kachchh district.

The Kachchh is one of the border districts of Gujarat State, lying between 22° to 24° latitudes and 68° to 72° longitude. It forms part of North-West Gujarat. As depicted in Figure 3.1, the district is surrounded by Sindh province of Pakistan in the North and the North-East, Rajasthan in the North-East, Surendra- nagar and Rajkot districts in the South-East, Gulf of Kachchh in the South and by Arabian sea in the West and Banaskantha and Mehsana districts in the East. From geographical point of view Kachchh is the largest district in Gujarat and the second largest district in India embracing 456 lakh hectares.

The district is divided into 9 talukas viz., Abdasa, Anjar, Bhachau, Bhuj, Lakhpat, Mandvi, Mundra, Nakhatrana and Rapar (Figure 3.2). There are 10 urban areas and 884 villages. The district head quarter is located at Bhuj. The district is sparsely populated and the density of population is only 28 persons per sq.km, which is the lowest in Gujarat. The total population of the district is 12,62,507 as per 1991 census. The population of scheduled castes and scheduled tribes is 1,50,235 and 87,723 respectively i.e. 19 per cent of total population. The literacy rate in the Kachchh district is 43.31 per cent.

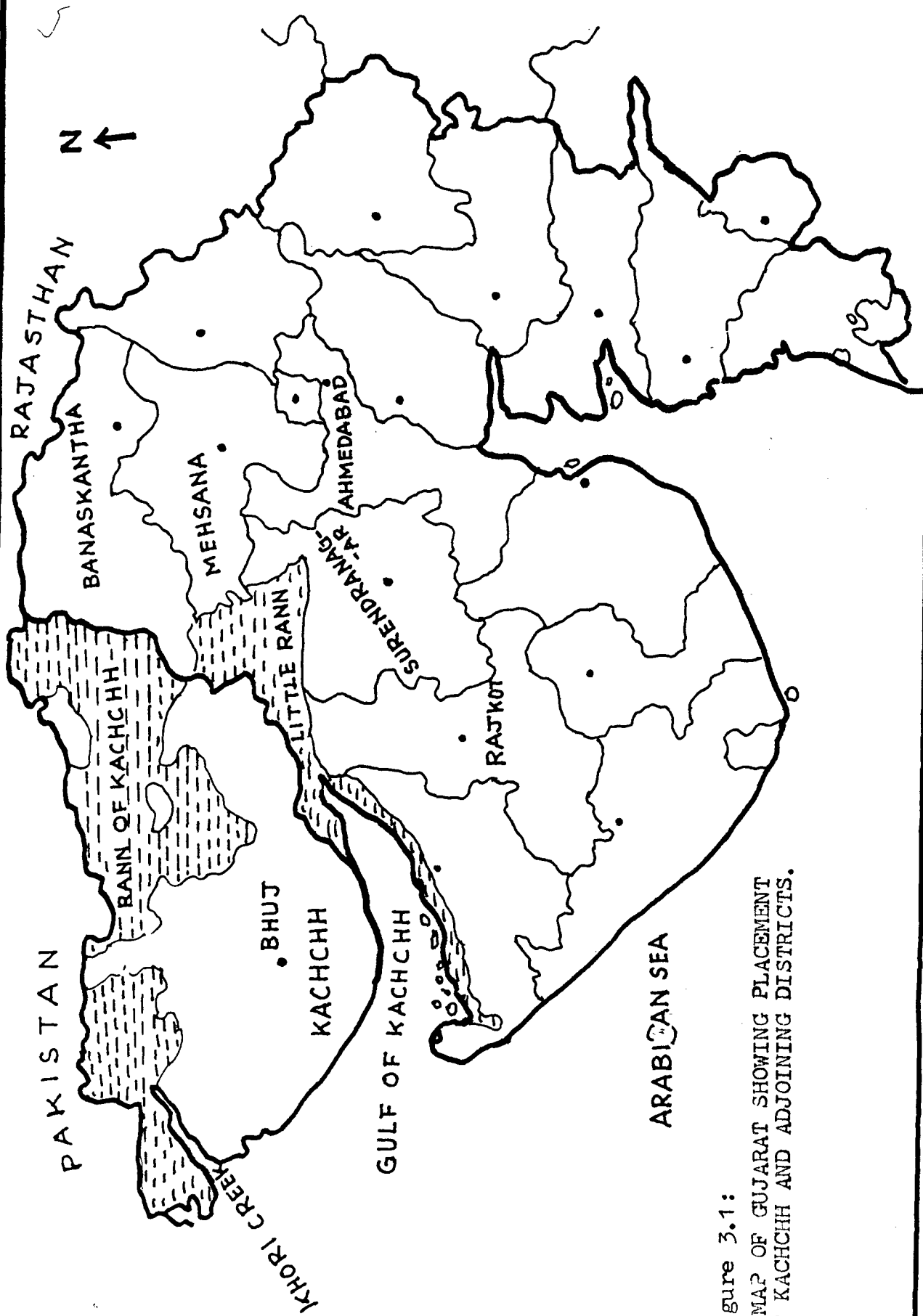
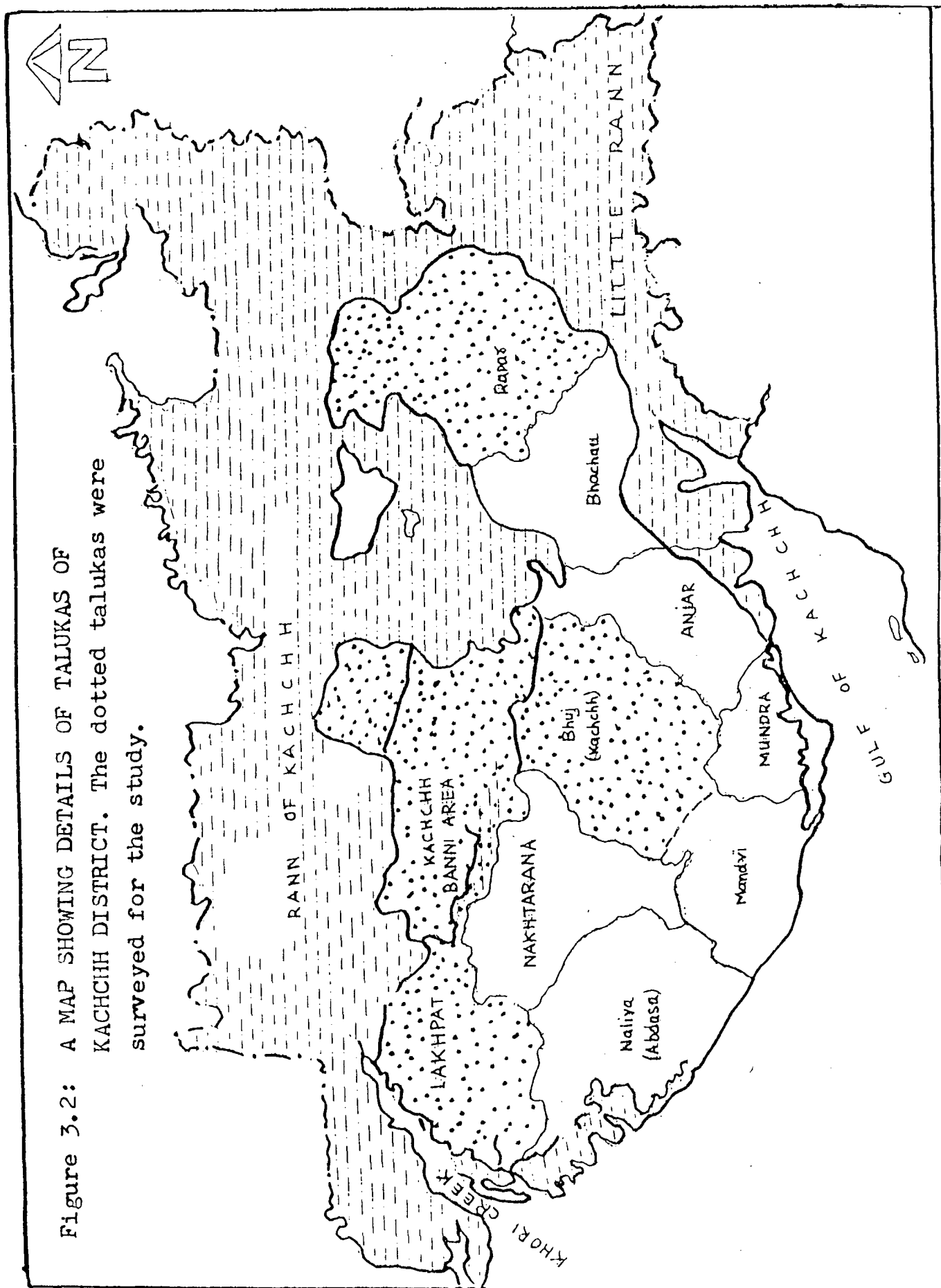


Figure 3.1:
A MAP OF GUJARAT SHOWING PLACEMENT
OF KACHCHH AND ADJOINING DISTRICTS.

Figure 3.2: A MAP SHOWING DETAILS OF TALUKAS OF KACHCHH DISTRICT. The dotted talukas were surveyed for the study.



Vast area of the district is having alluvial sandy soil with limited pocket of medium black soil. Desert area soils i.e. sandy to sandy-loam are found in the northern part of the district with high Sodium contents.

The climate of Kachchh is categorised as semi-arid with extreme winter and summer. In winter, the cold weather prevails from October to the end of February. The summer commences from the beginning of May and lasts upto the end of June. The ambient temperature almost touches freezing point in severe winter and 46°C in intense summer. The monsoon is moderately dry with maximum temperature rising upto 42°C. The monsoon commences from the beginning of June and lasts by the end of July with on an average 11 rainy days. Kachchh is receiving irregular and the lowest rainfall in Gujarat. Normal annual rainfall of the district is 350.6 mm. The whole of Kachchh is classified as drought prone area, except Mandvi and Mundra talukas. Out of the 6,15,440 hectares of cultivable land only 32,950 hectares (5.35 per cent) is under irrigation. Thus most of the land is rain fed. Therefore, livestock keeping and dry land farming are very important occupations in the district. Bajara and pulses are the major crops grown. In this region salinity of water is common. The district is known for its dry grass land. The Kachchh district is home tract of many important well-known livestock breed viz., Kankrej cattle, Kachchhi goats, Patanwadi sheep, Banni buffaloes and Kachchhi camels.

3.2 PLANNING OF EXPERIMENT

Kachchh district is the home tract of Kachchhi breed of camels. The present study was therefore planned to study the breed characteristics and traditional managerial practices followed by the camel breeders in the home tract. Survey work was conducted in three major thickly camel populated talukas of Kachchh district viz., Lakhapat, Bhuj and Rapar.

In order to study the breed characteristics and traditional managerial practices followed by the professional breeders of Kachchh district, 34 villages in three talukas involving 74 herds were surveyed covering three consecutive seasons starting from March to December, 1995. To delineate different breed characteristics and size of herd, observations were recorded from 326 camels, which were apparently healthy and of average condition.

3.3 QUALITATIVE CHARACTERISTICS

The study on different qualitative breed characteristics included body coat colour, colour marking if any on head, neck, body and tail, shape of udder, shape of teats, presence of extra teats and sheath were considered to establish the breed characteristics of Kachchhi camels.

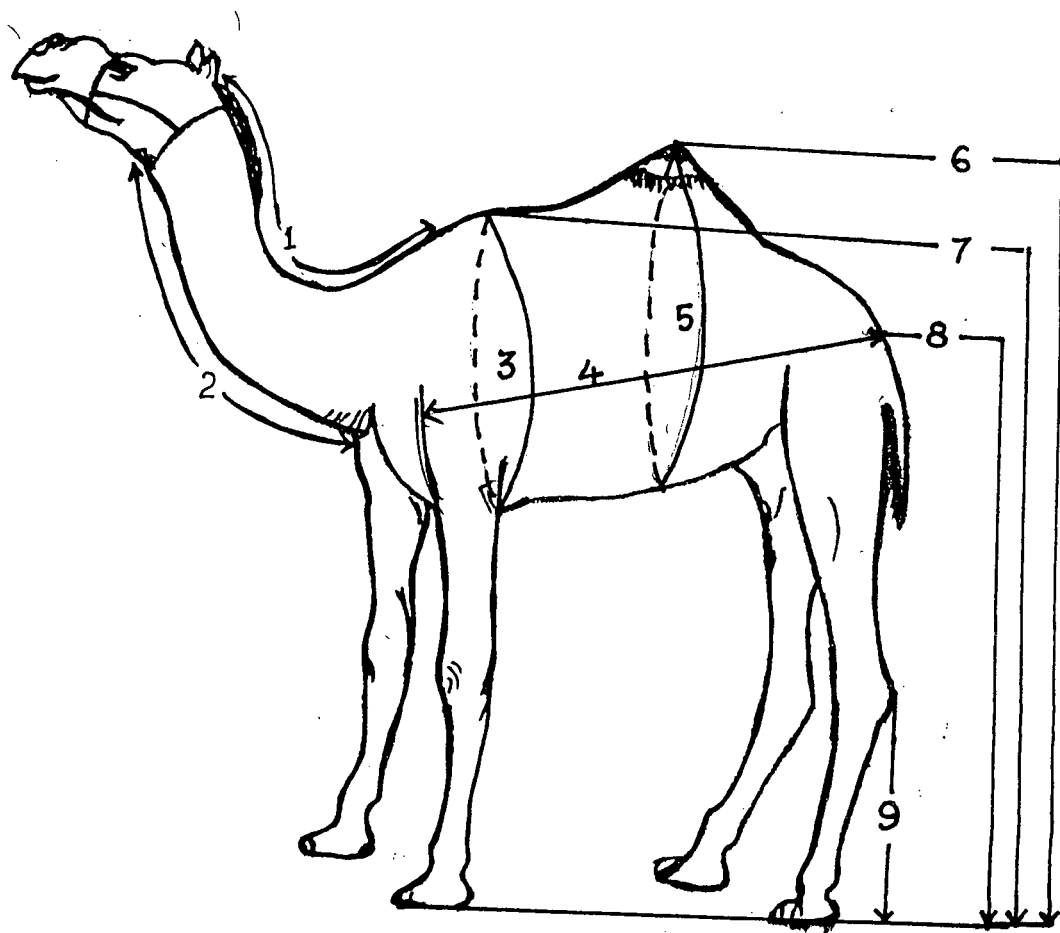
3.4 BODY MEASUREMENTS

Biometry of 326 animals was studied starting from at birth to adult stage viz., at birth, 3, 6 and 12 months of age and adulthood.

At the time of recording various body measurements, the animals were made to stand in a normal relaxed position on levelled ground. All the body measurements were measured in centimeters by a ^{flexible} steel carpenter tape as detailed below and Figure 3.3.

- 3.4.1 : Head length: The distance between level of two nostrils to the poll.
- 3.4.2 : Fore head length: The distance from the poll to central point between the eyes.
- 3.4.3 : Fore head width: The width of face immediately above eyes.
- 3.4.4 : Ear length: The distance between the base of the ear to tip of pinna.
- 3.4.5 : Ear width : The broadest width (distance) between two edges of pinna.
- 3.4.6 : Neck length : Upper side: The linear distance from poll to point of withers.
Lower side: The distance from throat to breast.
- 3.4.7 : Circumference of neck : The circumference of base of neck (tape describing a vertical circle as close as possible to anterior chest).
- 3.4.8 : Body length : The linear distance between point of shoulder and pin bone (tuberischii) i.e. oblique length was measured.
- 3.4.9 : Height at withers : The vertical distance from points of withers to the ground floor.
- 3.4.10: Height at shoulder joint : The vertical distance between the point of shoulder and the ground level.

Figure 3.3: Illustration showing the details of the body measurements.



1. Neck length (upper)
2. Neck length (lower)
3. Heart girth
4. Body length
5. Body girth at hump

6. Height at highest point of hump
7. Height at withers
8. Height at pin bone
9. Height at hock

- 3.4.11: Chest girth : The circumference of the body immediately behind the point of elbow on lowerside and point of withers above.
- 3.4.12: Body girth at the hump : The circumference of the body immediately behind the point of umbelicus on lowerside and highest point of hump above.
- 3.4.13: Height of knee : The measurement of vertical distance of knee from the ground level.
- 3.4.14: Circumference of hump : The circumference at the base of hump.
- 3.4.15: Height of hump : The length between the highest point of hump to the base of hump.
- 3.4.16: Height at highest point of hump: The vertical distance between the highest point of hump level and ground.
- 3.4.17: Height at hip joint : The vertical distances between point of hip joint and ground level.
- 3.4.18: Height at pin bone : The vertical distance between point of pin bone and ground level.
- 3.4.19: Height at stifle : The vertical distance between stifle joint to the ground level.
- 3.4.20: Height at hock : The vertical distance of hock joint from the ground level.
- 3.4.21: Tail length : The distance from the base to the tip of the tail.
- 3.4.22: Diameter of chest pad :
- (i) Vertical: It is longitudinal diameter of the pad taken in a cranio-caudal direction on its mid line along the long axis of the animal body.

(ii) Horizontal: It is a transverse diameter of the chest pad measured in a transverse direction of the pad, perpendicular to the preceding one.

3.4.23: Diameter of fore foot pad.

(i) Vertical: It is a longitudinal diameter of the fore foot pad taken in a cranio-caudal direction on its mid line along the long axis of the animal body.

(ii) Horizontal: It is a transverse diameter of the fore foot pad measured in transverse direction of the fore foot pad, perpendicular to the preceding one.

3.4.24: Diameter of rear foot pad.

(i) Vertical: It is a longitudinal diameter of the rear foot pad taken in a cranio-caudal direction on its mid line along the long axis of the animal body.

(ii) Horizontal: It is a transverse diameter of the rear foot pad measured in a transverse direction of the pad, perpendicular to the preceding one.

3.4.25: (i) Distance between fore leg: The distance covered between from centre point of right fore leg pad to the centre point of left fore leg pad.

(ii) Distance between hind leg: The distance covered between from centre point of right hind leg pad to the centre point of left hind leg pad.

3.4.26: (i) Circumference of fore leg foot pad: It is a measurement of the fore leg foot pad taken along the periphery (outer margin).

(ii) Circumference of hind leg foot pad: It is a measurement of the hind leg foot pad taken along the periphery (outer margin) of the foot pad.

3.5 BODY WEIGHT

Weighing facilities were not available in the villages of Kachchh district. Hence, body weights of adult Kachchhi camels were estimated from their heart girths using prediction equation given as under by Khanna *et al.* (1990b).

$$\text{Body weight (kg)} = 4.42 \times \text{heart girth (cm)} - 429.37$$

3.6 MILK PRODUCTION AND MILK COMPOSITION

Daily milk production of a she-camel was estimated by summation of production at three milkings i.e. at 7.00 a.m., 13.00 p.m. and 19.00 p.m. on the day of recording. All the milk production records were taken at mid stages (4th to 6 months) of lactations. Milk samples were collected after complete milking from 21 she-camels for estimation of milk composition. A milk sample of 200 ml was taken in a labelled plastic bottle with a 0.5 ml of 0.2 per cent formalin as a preservative. All the milk samples were kept in ice box during transport and then stored in refrigerator.

Standard laboratory procedures were followed for determination of various milk constituents viz., protein (Menefee and Overman, 1940), fat (Indian Standard, 1977), lactose (ISI, 1981), total solids (Laboratory manual, 1959), ash (Indian Standard, 1960) and specific gravity (Indian Standard, 1965).

3.7 REPRODUCTION PERFORMANCE

Monthwise calving distribution and calving interval were studied in Kachchhi camel kept at Government Camel Breeding Farm, Dhori (Kachchh).

3.8 MANAGEMENTAL PRACTICES

To survey the traditional managemental practices followed by the Kachchhi camel breeders, 74 professional camel breeders belonging to the three talukas of Kachchh district were selected for personal inquiry. Following inquiry was made by appropriate questionnaire (Appendix-A) to ascertain the status of traditional managemental practices as well as socio-economic status of the breeders.

3.8.1 Traditional camel breeder

Professional tribes of breeders, level of their education, major occupation, family income, residence, stationary or migratory herds, extent of migration etc. were recorded during the survey.

3.8.2 Herd size and its structure

Camels owned by each herd man surveyed were considered.

3.8.3 Feeding and watering practices

Information was collected by pre-set questionnaire on following aspects.

Browsing hours, preferences for browsing and grazing for trees, bushes and grasses during different seasons; Supplementary feeding to growing, breeding, pregnant and lactating camels. Source, amount and frequency of watering camels during different seasons.

3.8.4 Breeding practices

Breeding seasons, age at first oestrus, age at first service, oestrus symptoms, pregnancy diagnosis, calving symptoms, selection criteria for breeding male and female, method of breeding and age of selection for camel.

3.8.5 Care and management of camel calves

Colostrum feeding, milk feeding, supplementary feeds, housing of pregnant camels and of camel calves, care at birth and nurshing, age at weaning etc.

3.8.6 Marketing of surplus animals, milk and hair

Production, market price, marketing facilities etc. for animals, milk and hair.

3.8.7 Health care

Common camel diseases encountered, measures for prevention and treatment of diseases in the camels and traditional practices for the same.

3.9 MODEL CHROMOSOMAL PROFILE

The metaphase chromosomes were prepared from short-term leucocyte culture. The blood sample were aseptically collected from jugular vein of four Kachchhi camel (2 males + 2 females) maintained by traditional breeder in the region of Kachchh. The standard procedure using RPMI 1680 medium fortified with 10 per cent bovine foetal calf serum, Pokeweed mitogen (@ 2.5 μ m/ml) was followed. The whole blood cultures were set up for 72 hours

at 38°C. The standard procedure with use of colchicine, hypotonic treatment and fixation in acetic acid methanol was adopted. The metaphase spreads were stained by 4 per cent buffer Giemsa at pH 6.8. The chromosomes number were counted in twenty metaphase from each animals. The photomicrographs of metaphase plates (one from male and one from female) showing well spread chromosomes were taken. The karyotype was prepared on basis of relative length of chromosomes arranged in descending order. The short term culture and karyotype were prepared at Department of Animal Genetic and Breeding, College of Veterinary Science and Animal Husbandry, Anand.

3.10 STATISTICAL ANALYSIS

The information collected was statistically analysed by using appropriate standard statistical techniques as per Snedecor and Cochran (1980).

CHAPTER-IV

RESULTS AND DISCUSSION

Camel breeding in India is in the hands of nomadic tribes. These traditional camel breeders played crucial role in developing and preserving valuable germ plasm of camel breeds. The camel breeds so evolved and developed are most suited to harsh agroclimatic situation of arid and semi-arid zones. Very few attempts have been made to breed camels on scientific line in the country. There is also need for documentation of important camel breeds. With the objectives of documentation and evaluation of Kachchhi camels in their native tract for breed characters, their traditional managerial practices, feeding and feed resources and socio-economic aspects of camel breeders, the present investigation was undertaken.

Survey of 74 traditional camel breeding families and breed characterisation of 328 Kachchhi camels were the two important aspects of this investigation. The findings are presented and discussed in the chapter under the following heads.

4.1 Distinct breed characteristics of Kachchhi camels

4.2 Body measurements at different ages

4.2.1 Length of body parts

4.2.2 Height of body parts

4.2.3 Circumference of body parts

4.2.4 Relation between biometrical measurements

4.3 Body weight

4.4 Reproduction in camel

4.4.1 Age at first service

4.4.2 Breeding season

4.4.3 Signs of oestrus

4.4.4 Signs of pregnancy

4.4.5 Age at first calving

4.4.6 Calving interval

4.4.7 External signs of approaching parturition

4.5 Milk production

4.5.1 Milk yield

4.5.2 Traditional milking practices and milk disposal

4.5.3 Gross composition

4.6 Camel hair and utility

4.7 Model chromosomal profile

4.8 Traditional camel management practices

4.8.1 Traditional camel breeder

4.8.2 Camel pastoralism

4.8.3 Housing facilities

4.8.4 Feeding and watering management

4.8.5 Care and management of camels

4.8.6 Camel health

4.1 DISTINCT BREED CHARACTERISTICS OF KACHCHHI CAMELS

The Kachchhi camels are handsome in look and light to medium in size. Their body coat colour varies from dark brown

(Plate I) to brownish-white (Plate IV) with intermediate shades of brown (Plate II) and reddish-brown. Very few specimen entirely having black (Plate III) or white coats are also available. Rare specimen having reddish-brown coat colour with darker shades on head and neck locally referred as 'chavaro' colour are also seen.

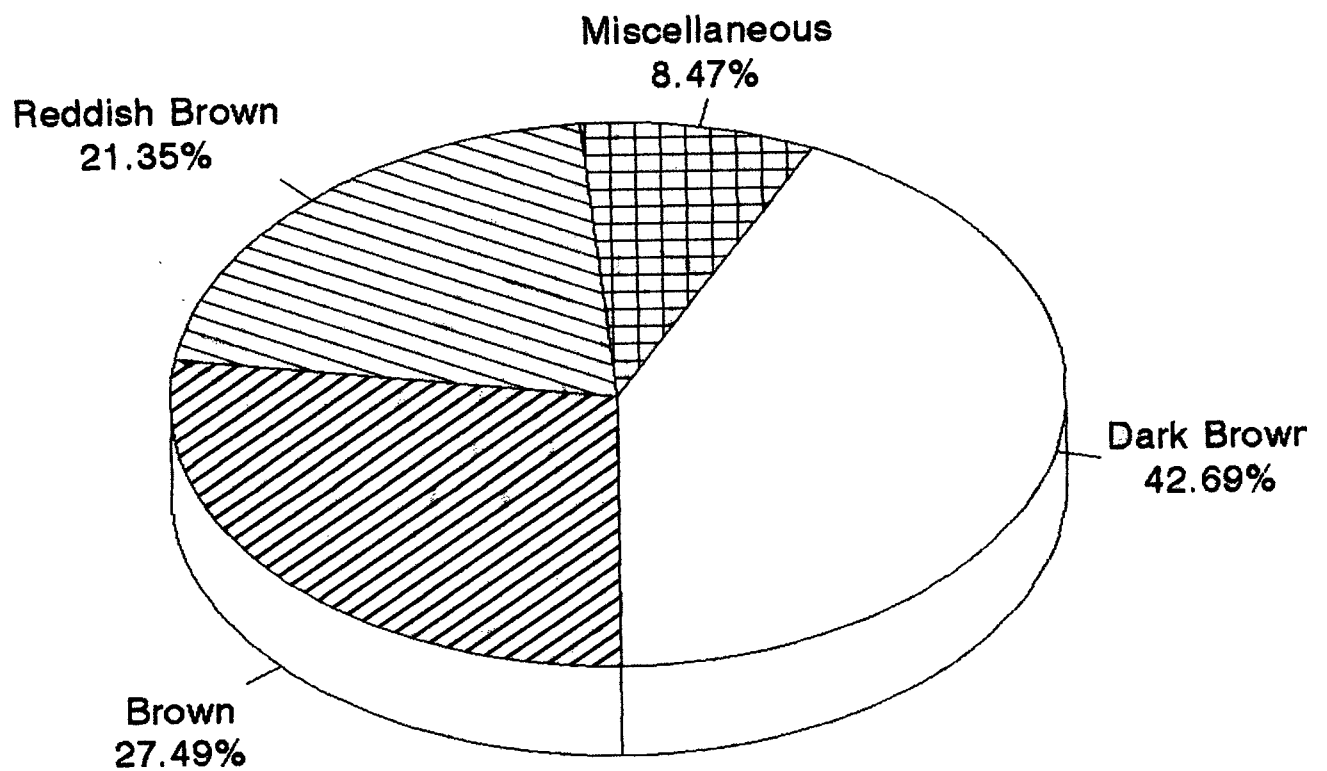
The frequency and percentage distribution of body coat colour in Kachchhi camels have been presented in Table 4.1.1 and Fig.4.1.

Table 4.1.1 Frequency and percentage distribution of body coat colour in different age groups

Colour	Age group												Total	
	<u>At birth</u>		<u>3 months</u>		<u>6 months</u>		<u>9 months</u>		<u>1 year</u>		<u>Adult</u>			
	No.of animals	Per cent	No.of animals	Per cent	No.of animals	Per cent	No.of animals	Per cent	No.of animals	Per cent	No.of animals	Per cent	Freq-ency	Per cent
Dark-brown	9	36.00	7	50.00	11	45.83	6	37.50	23	38.99	90	44.12	146	42.69
Brown	8	32.00	5	35.71	6	25.00	6	37.50	17	28.81	52	25.49	94	27.49
Reddish-brown	3	12.00	2	14.29	5	20.83	3	18.75	17	28.81	43	21.09	73	21.35
Brownish-white	2	8.00	0	0.00	1	4.17	0	0.00	2	3.39	5	2.45	10	2.92
Chavaro	2	8.00	0	0.00	0	0.00	1	6.25	0	0.00	10	4.90	13	3.80
Black	1	4.00	0	0.00	1	4.17	0	0.00	0	0.00	3	1.47	5	1.46
White	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	0.49	1	0.29
Total	25	100.00	14	100.00	24	100.00	16	100.00	59	100.00	204	100.00	342	100.00

The dark-brown coat colour was the most common (42.69%) coat colour in the Kachchhi camels. Brown (27.49%) and reddish-

Figure 4.1 Distribution of Coat Colour in Kachchhi Camel



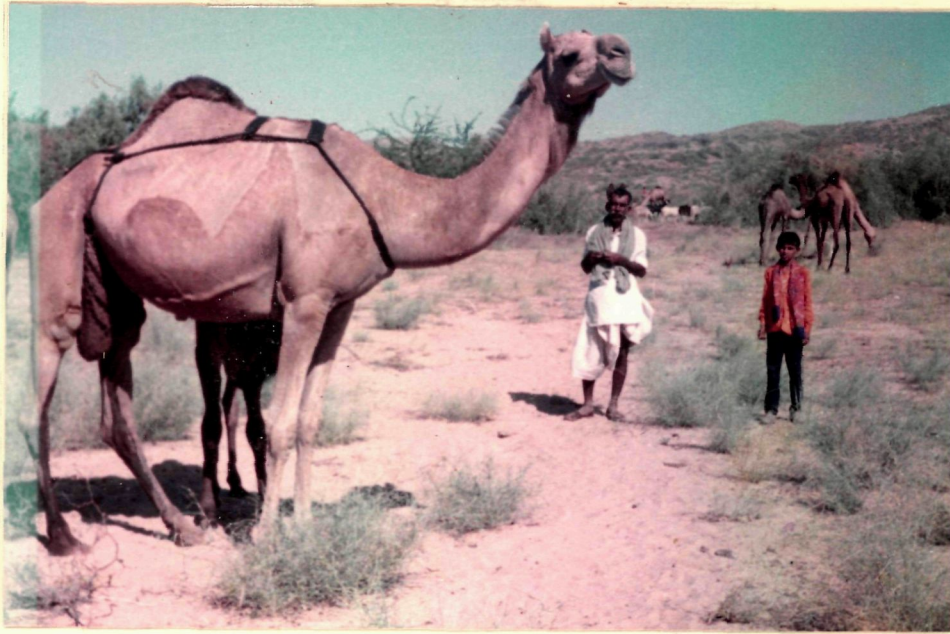


Plate I: Photograph showing a general outlook of a Kachchhi she-camel with dark-brown colour.

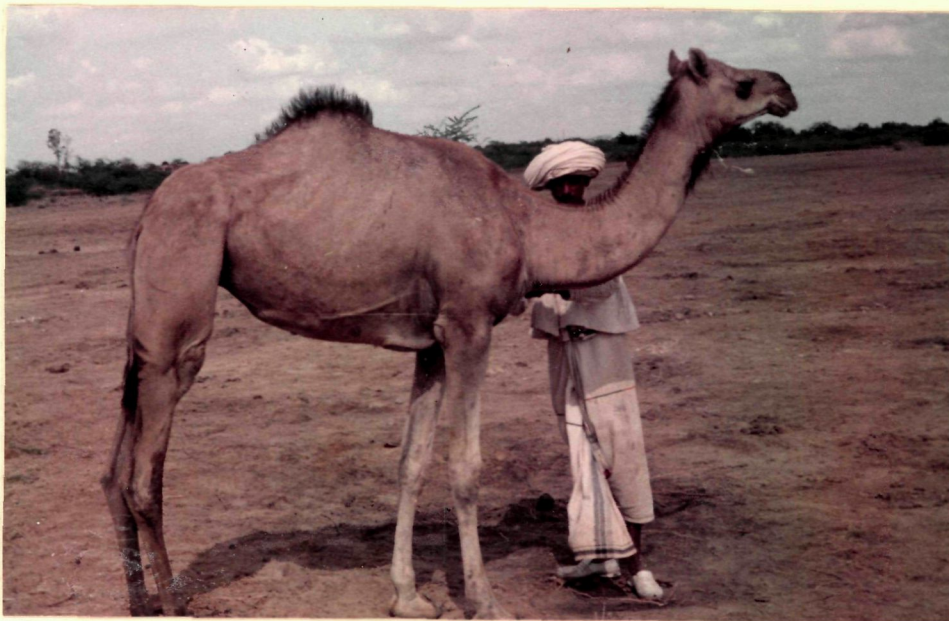


Plate II: Photograph showing brown coat, light body and handsome look of a Kachchhi camel. Please note typical ears of the camel.

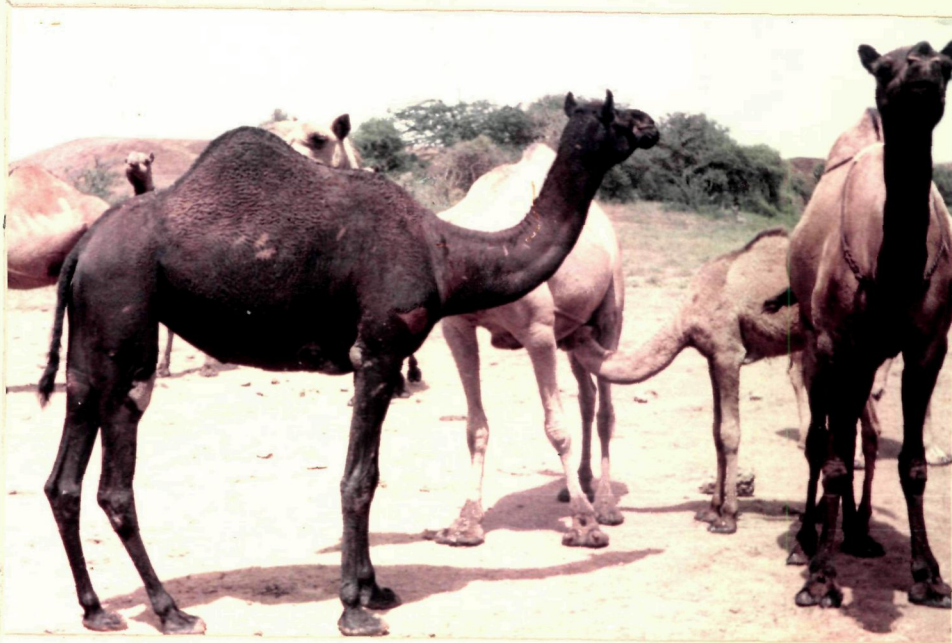


Plate III: A Kachchhi camel with black body coat.

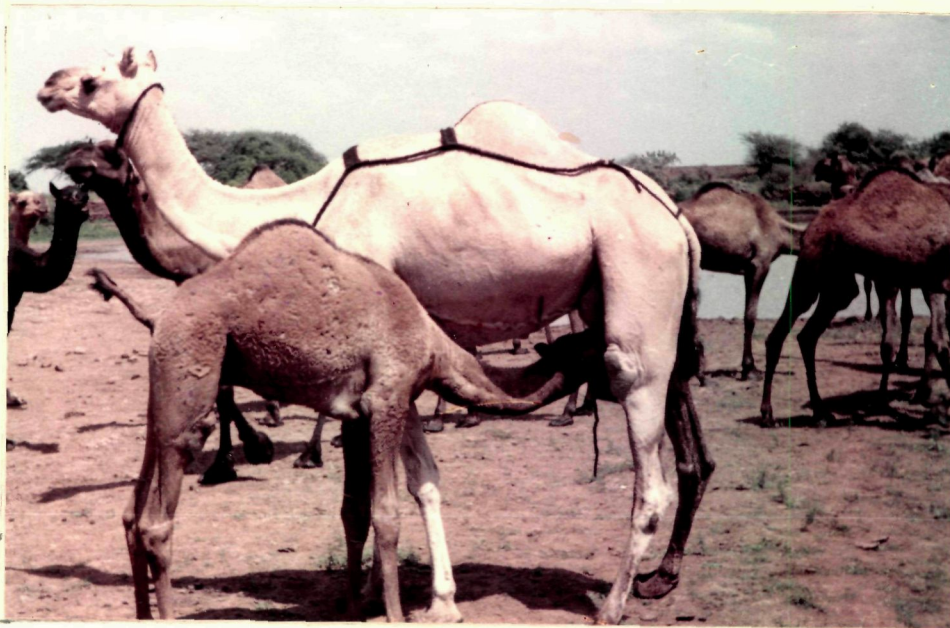


Plate IV : A Kachchhi she-camel having brownish white coloured coat with brownish calf at foot.

brown (21.35%) were also important coat colours prevailing in the camels. The pattern in body coat colour observed in the Kachchhi camels was more or less same in the different age groups. These observations on coat colour corroborated with findings of Kohler-Rollefson (1992) for the Kachchhi camel.

The Kachchhi camels had small and erect ears. The tips of the ears were turning in, which responded well to noise. This characteristics of Kachchhi camel is locally known as 'Tikha' means sharp (Plate II). The camels had small and well set muzzles and lips. Adult she-camels had capacious bowl shaped udders with medium sized cylindrical teats (Plate V) indicating higher milk production potential of the animals.

The small and slim head on long neck of the Kachchhi camel attracted our attention (Plate VI). The type of head having erect ears (which were turning in), well set muzzle and lips, and capacious udder were distinguished physical characters of the Kachchhi camels.

4.2 BODY MEASUREMENTS AT DIFFERENT AGES

Describing physical characters of any breed without reference to biometry will be incomplete. Important body measurements of 326 Kachchhi camels were made in field condition, covering different age groups viz., at birth, 3 months, 6 months, 1 year and adult age.

4.2.1 Length of body parts

Average length of important body parts recorded in different age groups of the Kachchhi camels is presented in Table 4.2.1.



Plate V : Capacious udder and moderate size of teat in a Kachchhi camel.



Plate VI : Closer view of head of a male Kachchhi camel.

Table 4.2.1 Length of important body parts in different age groups of Kachchhi camels

Measurements (cm)	Age groups									
	Birth		3 months		6 months		1 year		Adult	
	Male (12)	Female (13)	Male (5)	Female (9)	Male (12)	Female (12)	Male (29)	Female (38)	Male (28)	Female (176)
Head length	24.42 ±0.59	24.92 ±0.59	29.80 ±0.37	29.67 ±0.55	31.92 ±0.92	31.17 ±0.79	37.90 ±0.34	37.47 ±0.41	46.36 ±0.37	49.23 [†] ±0.29
Forehead length	14.42 ±0.43	13.85 ±0.27	16.40 ±0.93	16.86 ±0.44	16.38 ±0.33	16.17 ±0.41	18.26 ±0.26	17.65 ±0.26	23.18 ±0.47	21.81 [†] ±0.14
Width of forehead	14.58 ±0.58	14.54 ±0.62	18.80 ±0.97	18.83 ±0.94	19.83 ±0.65	19.80 ±0.46	24.38 ±0.26	23.78 ±0.33	28.29 ±0.48	26.74 [†] ±0.24
Ear length	6.58 ±0.21	7.15 ±0.24	8.60 ±0.60	7.83 ±0.37	9.38 ±0.18	9.25 ±0.23	10.47 ±0.21	10.38 ±0.16	11.89 ±0.22	11.71 ±0.18
Width of ear	4.67 ±0.26	5.08 ±0.18	6.10 ±0.19	5.89 ±0.22	6.17 ±0.22	6.13 ±0.23	6.88 ±0.13	6.75 ±0.15	7.68 ±0.16	7.72 ±0.84
Neck length at										
a) Upper crest	54.92 ±1.70	56.88 ±1.82	79.40 ±1.17	75.78 ±1.85	98.42 ±4.89	88.83 ±4.76	103.45 ± 2.85	104.88 ± 2.38	121.75 ± 2.31	124.38 ± 0.78
b) Lower side	48.58 ±0.74	43.54 ±1.68	67.80 ±1.85	68.22 ±2.11	81.58 ±4.41	78.58 ±4.44	85.64 ±0.94	86.83 ±1.71	106.43 ± 2.11	107.15 ± 0.69
Body length	61.17 ±1.32	61.46 ±1.81	86.60 ±2.62	85.11 ±2.19	97.58 ±1.99	97.75 ±2.65	118.98 ± 1.73	117.17 ± 2.23	159.82 ± 2.18	156.15 ± 0.76
Distance between forelegs	28.38 ±1.70	28.62 ±1.32	32.40 ±1.50	33.78 ±2.63	38.42 ±1.32	28.83 ±1.38	38.81 ±1.47	36.12 ±1.63	48.79 ±1.26	38.46 ±0.46
Distance between hindlegs	27.17 ±1.93	24.54 ±1.32	42.28 ±2.42	37.88 ±3.81	31.17 ±1.98	35.42 ±2.84	41.79 ±2.84	42.83 ±1.78	42.32 ±1.33	49.82 [†] ±0.60
Tail length	28.29 ±0.88	28.23 ±0.66	35.80 ±0.55	37.11 ±0.89	48.83 ±1.23	39.25 ±0.98	43.97 ±0.68	42.98 ±0.78	56.29 ±0.61	52.38 [†] ±0.24

Figures in the parenthesis indicate the number of observations.

* Sex difference significant for the trait in the age group (P < 0.05).

Average head length measured 24.42 ± 0.58 , 29.80 ± 0.37 , 31.92 ± 0.92 , 37.90 ± 0.34 ; and 46.36 ± 0.37 cm in male and 24.92 ± 0.58 , 29.67 ± 0.55 , 31.17 ± 0.78 , 37.47 ± 0.41 and 49.23 ± 0.28 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively of the Kachchhi camels. In the male and female Kachchhi camels head length was comparable upto 1 year of age. However, the head length at adulthood was significantly ($P < 0.05$) higher in the female than in the male camel.

Average length of forehead was 14.42 ± 0.43 , 16.40 ± 0.93 , 16.38 ± 0.33 , 18.26 ± 0.26 and 23.18 ± 0.47 cm in male; and 13.85 ± 0.27 , 16.06 ± 0.44 , 16.17 ± 0.41 , 17.65 ± 0.26 and 21.81 ± 0.14 cm in female Kachchhi camel at birth, 3 months, 6 months, 1 year and adult age, respectively. Similarly average width of forehead was 14.58 ± 0.58 , 18.80 ± 0.97 , 19.83 ± 0.65 , 24.38 ± 0.26 and 28.29 ± 0.48 cm in male; and 14.54 ± 0.62 , 18.83 ± 0.84 , 19.00 ± 0.46 , 23.70 ± 0.33 and 26.74 ± 0.24 cm in female Kachchhi camel at birth, 3 months, 6 months, 1 year and adult age, respectively. Both length and width of the forehead were comparable in male and female Kachchhi camels upto 1 year of age. However, both these measurements were significantly ($P < 0.05$) higher in the male than the female camels at adult age. Thus, adult males have massive head as compared to adult females of Kachchhi camels. Average width of forehead observed in the study at different ages of Kachchhi camels were within the range as recorded by Anonymous (1987) in Indian camels.

The ears of Kachchhi camels were having length of 6.58 ± 0.21 , 8.60 ± 0.60 , 9.38 ± 0.18 , 10.47 ± 0.21 and 11.89 ± 0.22 cm in male; and 7.15 ± 0.24 , 7.83 ± 0.37 , 9.25 ± 0.23 , 10.30 ± 0.16 and 11.71 ± 0.10 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. The ears of Kachchhi camels were having width of 4.67 ± 0.26 , 6.10 ± 0.19 , 6.17 ± 0.22 , 6.88 ± 0.13 and 7.68 ± 0.16 cm in male; and 5.08 ± 0.18 , 5.89 ± 0.22 , 6.13 ± 0.23 , 6.75 ± 0.15 and 7.72 ± 0.04 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. The sex difference in the measurements of the ears was non-significant. The length of the ear was higher than its width.

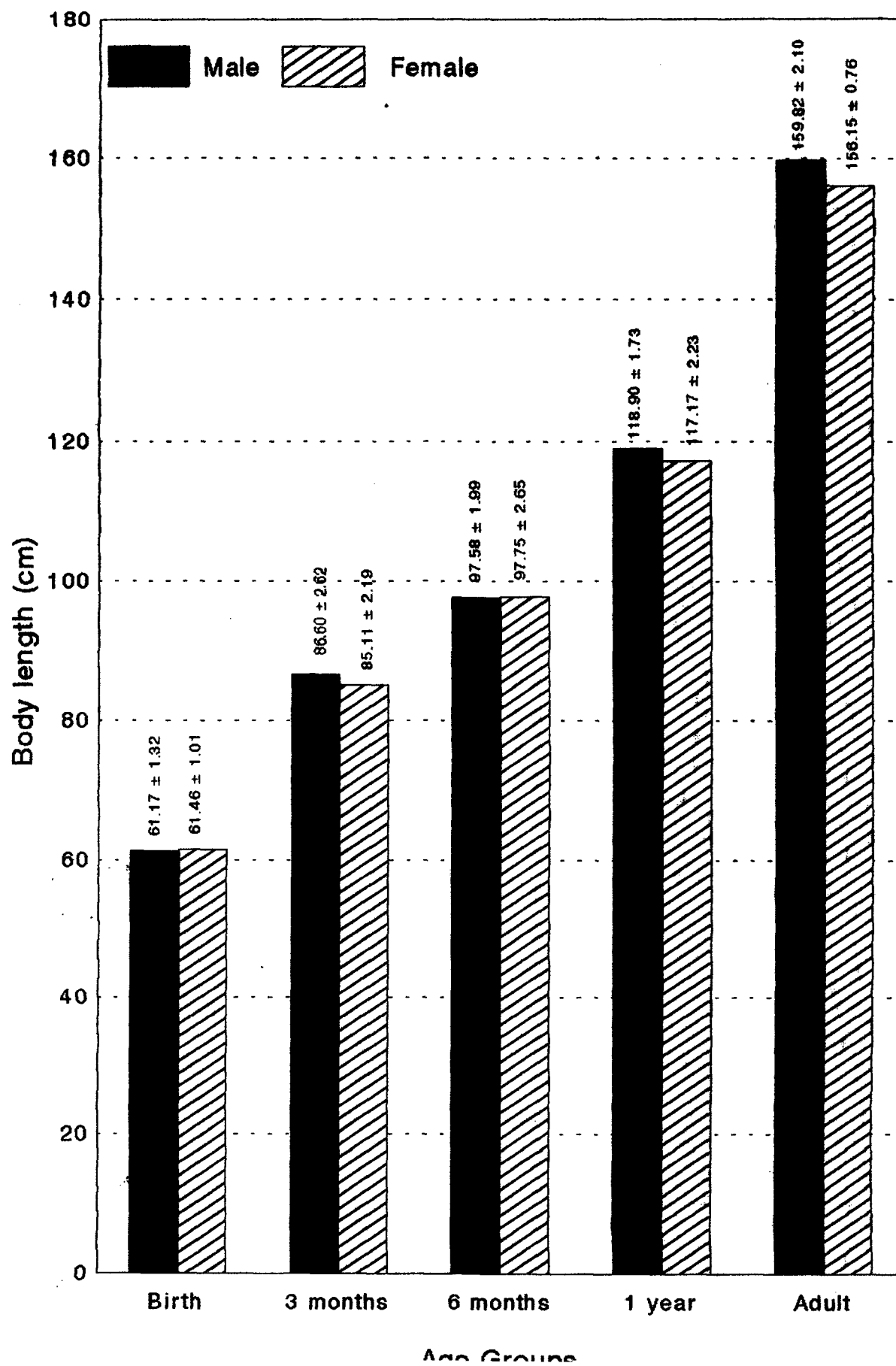
The neck of the camel is not only giving gracious appearance but is useful in browsing from tall trees and shrubs. On an average the (upper) length of neck in the Kachchhi camel measured 54.92 ± 1.70 , 79.40 ± 1.17 , 90.42 ± 4.89 , 103.45 ± 2.05 and 121.75 ± 2.31 cm for males; and 56.08 ± 1.82 , 75.78 ± 1.85 , 88.83 ± 4.76 , 104.00 ± 2.30 and 124.30 ± 0.70 cm for females at birth, 3 months, 6 months, 1 year and adult age, respectively, whereas, on an average the (lower) length of the neck measured 40.58 ± 0.74 , 67.00 ± 1.05 , 81.50 ± 4.41 , 85.64 ± 0.94 and 108.43 ± 2.11 cm in male; and 43.54 ± 1.60 , 68.22 ± 2.11 , 78.50 ± 4.44 , 88.83 ± 1.71 and 107.15 ± 0.69 cm in female of different age groups, respectively. The neck at crest was longer than that at lower side. The measurements of the neck were at par in both the sexes of different age groups.

The length of neck observed here in the adult Kachchhi camels was higher than values reported for Kachchhi camels and was comparable with values reported for Bikaneri camel kept at NRCC, Bikaner (Anonymous, 1991 and Anonymous, 1992). The reports could not bring out any significant sex difference in the trait.

Average, length of body in the Kachchhi camel (Table 4.2.1 and figure 4.2) was 61.17 ± 1.32 , 86.60 ± 2.62 , 97.58 ± 1.99 , 118.90 ± 1.73 and 159.82 ± 2.10 cm in males; and 61.46 ± 1.01 , 85.11 ± 2.19 , 97.75 ± 2.65 , 117.17 ± 2.23 and 156.15 ± 0.76 cm in females at birth, 3 months, 6 months, 1 year and adult age, respectively. The body length of the camels increased with advancement of their age. The sex differences in the body length were not appreciable in the different age groups. The body length of Kachchhi camel recorded in this study corroborate with the observation of Anonymous (1992) in the breed. However, Sharma and Bhargava (1963) and Anonymous (1992) reported higher values of body length in Bikaneri camels. This indicated that the Kachchhi camels are shorter in length than the Bikaneries.

Placement of hind and fore legs is important for keeping balance and stride of the animal. It can be measured from the distance between foot pads of the legs. Average distance between forelegs was 28.38 ± 1.70 , 32.40 ± 1.50 , 30.42 ± 1.32 , 38.81 ± 1.47 , 40.79 ± 1.26 cm in male; and 28.62 ± 1.32 , 33.78 ± 2.63 , 28.83 ± 1.30 , 36.12 ± 1.63 and 38.46 ± 0.46 cm in female Kachchhi camels at birth, 3 months, 6 months, 1 year and adult age, respectively. Average distance between hindlegs was 27.17 ± 1.93 ,

Figure 4.2 : Body length (cm) of Kachchhi Camel



42.20 \pm 2.42, 31.17 \pm 1.98, 41.79 \pm 2.04 and 42.32 \pm 1.33 cm in male; and 24.54 \pm 1.32, 37.00 \pm 3.81, 35.42 \pm 2.04, 42.83 \pm 1.78 and 49.02 \pm 0.60 cm in female Kachchhi camels at birth, 3 months, 6 months, 1 year and adult age, respectively. The sex difference for distance between legs were non-significant for most of the age groups, except the distance between hindlegs in adult Kachchhi camels. In the female Kachchhi camel, hindlegs set apart than those in the male. There is no clear cut consistency in the trend for distance between fore as well as hindlegs, indicating scope for improvement in these trait by selection.

The tail of Kachchhi camel was having average length of 28.29 \pm 0.88, 35.00 \pm 0.55, 40.83 \pm 1.23, 43.97 \pm 0.60 and 56.29 \pm 0.61 cm in male; and 28.23 \pm 0.66, 37.11 \pm 0.89, 39.25 \pm 0.98, 42.90 \pm 0.70 and 52.38 \pm 0.24 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. The average tail length of Kachchhi camel noticed in this study is slightly lesser than that reported for Bikaneri camel (Sharma and Bhargava, 1963 and Bhargava *et al.*, 1965) especially at adult age. Thus Kachchhi camels have slightly shorter tails than Bikaneries.

4.2.2 Height of body parts

Average heights of important body parts in different age groups of the Kachchhi camels measured in field condition are presented in Table 4.2.2.

Average height at withers recorded (Fig.4.3) for the Kachchhi camel in standing position was 110.42 \pm 1.35, 137.20 \pm

1.36, 137.92 ± 2.66 , 158.79 ± 2.43 and 185.00 ± 3.35 cm in male; and 109.15 ± 1.13 , 136.89 ± 1.84 , 142.75 ± 3.60 , 158.57 ± 2.04 ,

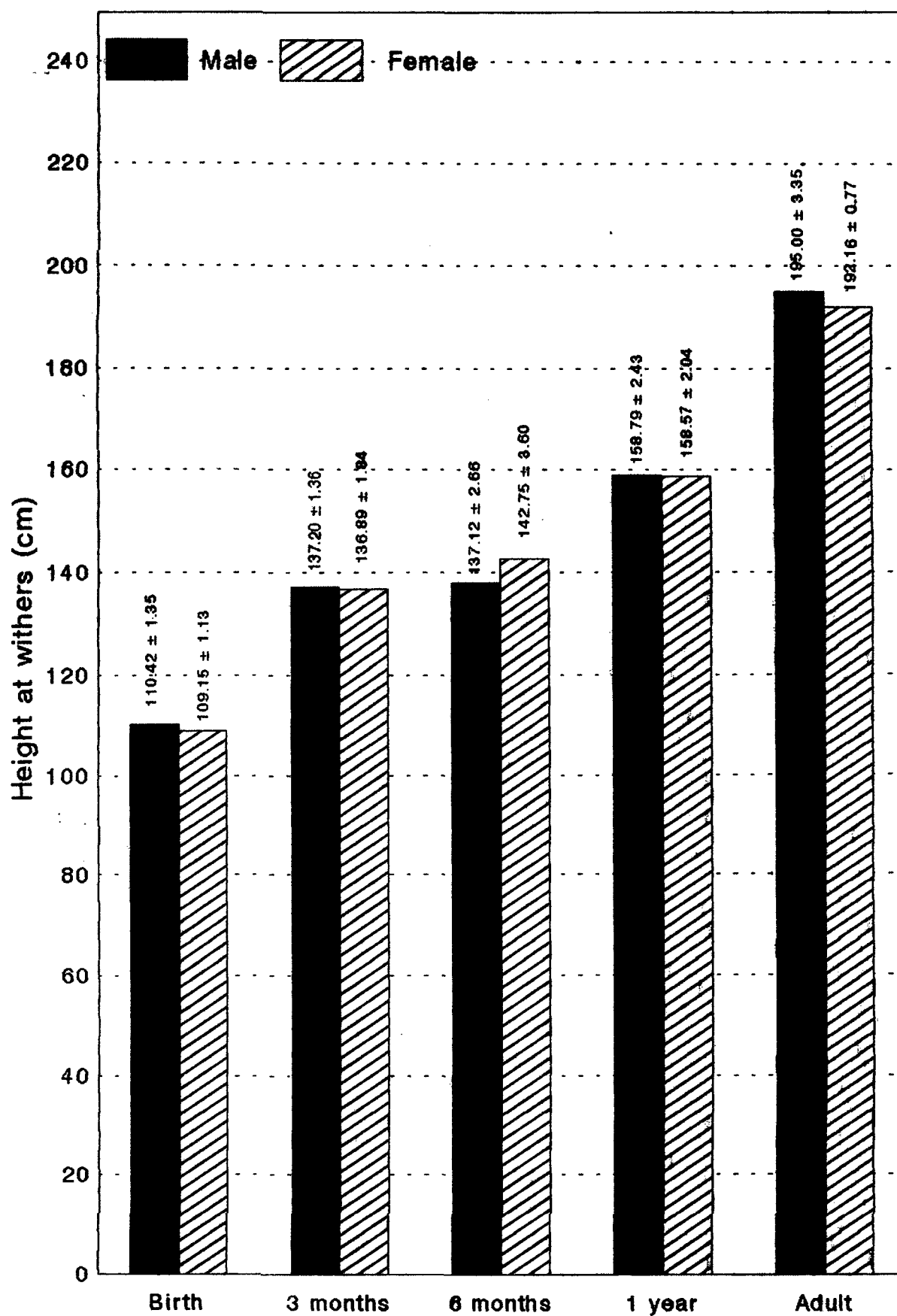
Table 4.2.2 Height of important body parts in different age groups of Kachchhi camels

Measurements (cm)	Age groups									
	Birth		3 months		6 months		1 year		Adult	
	Male (12)	Female (13)	Male (5)	Female (9)	Male (12)	Female (12)	Male (29)	Female (30)	Male (28)	Female (176)
Height at wither	110.42 ± 1.35	109.15 ± 1.13	137.20 ± 1.36	136.89 ± 1.84	137.12 ± 2.66	142.75 ± 3.60	158.79 ± 2.43	158.57 ± 2.04	195.00 ± 3.35	192.16 ± 0.77
Height at shoulder point	88.88 ± 1.66	88.85 ± 1.14	105.40 ± 1.00	104.56 ± 1.63	106.88 ± 0.94	106.67 ± 2.30	124.48 ± 1.02	122.80 ± 1.24	148.68 ± 1.55	141.15 [†] ± 0.59
Height at knee	41.75 ± 0.51	41.30 ± 0.52	46.40 ± 1.12	48.78 ± 0.91	47.88 ± 0.34	48.83 ± 1.26	54.03 ± 0.54	53.67 ± 0.49	60.43 ± 0.55	57.10 [†] ± 0.22
Height of hump	5.58 ± 0.88	4.88 ± 0.32	13.00 ± 1.70	14.33 ± 1.00	10.88 ± 1.44	17.00 ± 1.33	16.42 ± 0.90	17.53 ± 0.72	24.25 ± 1.35	28.57 [†] ± 0.57
Height at highest point of hump	110.92 ± 1.72	110.92 ± 1.77	142.40 ± 4.93	147.89 ± 2.02	155.25 ± 3.21	152.67 ± 2.49	171.34 ± 2.30	175.30 ± 2.55	218.54 ± 2.10	207.33 [†] ± 0.87
Height at hip joint	88.68 ± 2.12	90.00 ± 1.30	110.80 ± 1.16	108.44 ± 1.69	111.33 ± 1.79	112.92 ± 2.41	128.91 ± 1.14	126.80 ± 1.33	154.75 ± 1.10	146.51 [†] ± 0.47
Height at pin bone	91.33 ± 2.11	93.31 ± 1.28	113.40 ± 1.57	111.56 ± 1.77	113.00 ± 0.67	116.42 ± 2.48	132.05 ± 0.89	130.30 ± 1.32	158.75 ± 1.10	150.74 [†] ± 0.46
Height at stifle	70.83 ± 1.47	69.23 ± 0.66	83.50 ± 1.33	76.67 ± 7.25	85.80 ± 0.80	85.00 ± 1.15	97.97 ± 0.70	97.37 ± 0.88	111.82 ± 0.73	106.72 [†] ± 0.34
Height at hock	44.71 ± 0.73	43.23 ± 0.67	48.83 ± 1.22	48.33 ± 1.24	51.60 ± 0.40	49.22 ± 1.14	57.66 ± 0.66	56.93 ± 0.86	62.79 ± 0.71	61.61 ± 0.29

Figures in the parenthesis indicates the number of observations

* Sex difference significant for the trait in the age group
($P < 0.05$)

Figure 4.3 : Height at withers (cm) of Kachchhi Camel



and 192.16 ± 0.77 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. The height at wither increased linearly with advancement of age in the Kachchhi camel without appreciable sex difference. In comparison to the observation of present investigation, Anonymous (1992) reported slightly lower height at wither (102 cm) at birth but comparable (189.80 - 195.83 cm) height at withers at adult age in Kachchhi camel. The values were higher in Bikaneri camels than in the Kachchhi camels.

Average height at shoulder point was 88.08 ± 1.66 , 105.40 ± 1.08 , 106.08 ± 0.94 , 124.48 ± 1.02 and 148.88 ± 1.55 cm in male; and 88.85 ± 1.14 , 104.56 ± 1.63 , 108.67 ± 2.30 , 122.80 ± 1.24 and 141.15 ± 0.59 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. Similarly average height at knee was 41.75 ± 0.51 , 46.40 ± 1.12 , 47.08 ± 0.34 , 54.03 ± 0.54 and 60.43 ± 0.55 cm in male; and 41.30 ± 0.52 , 48.78 ± 0.81 , 48.83 ± 1.26 , 53.67 ± 0.49 and 57.10 ± 0.22 cm in female Kachchhi camel at different age, respectively. Average height at both these joints increased with increasing age of the animals. Both these heights were significantly ($P < 0.05$) influenced by sex, only at adult hood with higher values in male. Anonymous (1992) also indicated that the males have longer forelegs than females in Bikaneri, Jaisalmeri and Kachchhi camels.

Average height of hump was 5.58 ± 0.88 , 13.00 ± 1.70 , 18.08 ± 1.44 , 18.42 ± 0.90 and 24.25 ± 1.35 cm in male; and 4.88 ± 0.32 , 14.33 ± 1.00 , 17.00 ± 1.33 , 17.53 ± 0.72 and 28.57 ± 0.57

cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. The sex differences in height of hump upto 1 year were non-significant. The height of the hump in Kachchhi camel was greater ($P < 0.05$) in females, than that in males. This might be due to lesser fat storage in the hump of males than that of females, especially during rutting season.

On an average heights of the Kachchhi camels at the highest point of hump measured were 110.92 ± 1.72 , 142.40 ± 4.93 , 155.25 ± 3.21 , 171.34 ± 2.30 and 218.54 ± 2.10 cm for males; and 110.92 ± 1.77 , 147.89 ± 2.02 , 152.67 ± 2.49 , 175.30 ± 2.55 and 207.33 ± 0.87 cm for females at birth, 3 months, 6 months, 1 year and adult age, respectively. The males were having significantly ($P < 0.05$) higher height at hump than females, only in adulthood. The observations on height of hump of the Kachchhi camels were not corroborating with the observations on height of the animals at highest point of hump.

The height at the highest point of hump recorded in the Kachchhi camels during the survey was lower than that reported for Bikaneri camels at respective ages (Bhargava *et al.*, 1965 and Chowdhary, 1986a). Thus Bikaneri camels are taller, when considered height at the highest point of hump also.

Average height at hip joint was 88.88 ± 2.12 and 90.00 ± 1.30 cm at birth and 154.75 ± 1.10 and 146.51 ± 0.47 cm in adulthood, respectively in male and female Kachchhi camels. Similarly, in the camel average height at pin bone was 91.33 ± 2.11 and 93.31 ± 1.28 cm at birth and 158.75 ± 1.10 and $150.74 \pm$

0.46 cm at adult age, respectively in male and female. The sex differences in the measurements were only significant for the adult camels. The males were having higher heights at these points than those in the females adulthood. Height at pin bone recorded in the present study for the Kachchhi camel is within the range reported for Bikaneri camel (Sharma and Bhargava, 1963 and Bhargava *et al.*, 1965).

Average height at stifle was 70.83 ± 1.47 and 69.23 ± 0.66 cm at birth and 111.82 ± 0.73 and 106.72 ± 0.34 cm in adulthood, respectively in male and female Kachchhi camels. Similarly, in the camels height at hock was 44.71 ± 0.73 and 43.23 ± 0.67 cm at birth and 62.79 ± 0.71 and 61.61 ± 0.29 cm at adult age, respectively in male and female. The effect of sex was not appreciable on both these parameters at different ages except height at stifle in adult camels. The male adult camels had significantly ($P < 0.05$) higher height at stifle than that in the females. Bhargava *et al.* (1965) observed higher height of hock at birth and Sharma and Bhargava (1963) observed higher height of hock at adult age in Bikaneri camels than the values recorded for the Kachchhi camels at respective age during the study.

4.2.3 Circumference of body parts

Average circumference of important body parts of the Kachchhi camels in different age groups are presented in Table 4.2.3.

Average heart girth of the Kachchhi camels (Fig.4.4) was 76.92 ± 2.81 , 109.80 ± 2.15 , 120.33 ± 2.39 , 150.62 ± 2.66 and

195.93 \pm 2.11 cm in male; and 72.77 \pm 1.56, 114.00 \pm 1.63, 120.33 \pm 3.21, 148.27 \pm 2.83 and 204.75 \pm 10.77 cm in female at birth, 3 months, 6 months, 1 year and adult age, respectively. Similarly, average body girth at hump of the Kachchhi camel was 77.67 \pm 3.19, 126.60 \pm 4.34, 146.83 \pm 3.75, 175.66 \pm 2.98 and 242.04 \pm 7.49 cm in male; and 74.15 \pm 2.09, 133.44 \pm 1.43, 151.08 \pm 5.44, 180.17 \pm 3.07 and 245.24 \pm 1.90 cm in female, respectively. As expected, body girth is higher than heart girth in the camels at all the ages. Both these girths increase with age of animals suggesting linear growth of animals. Interestingly heart girth as well as body girth were not influenced by the sex of the camel. The observation made on the Kachchhi camel at birth and adult age during the study are in agreement with those on Kachchhi camels reported by Anonymous (1992). The Bikaneri camels had comparatively larger heart girth than the Kachchhi camels.

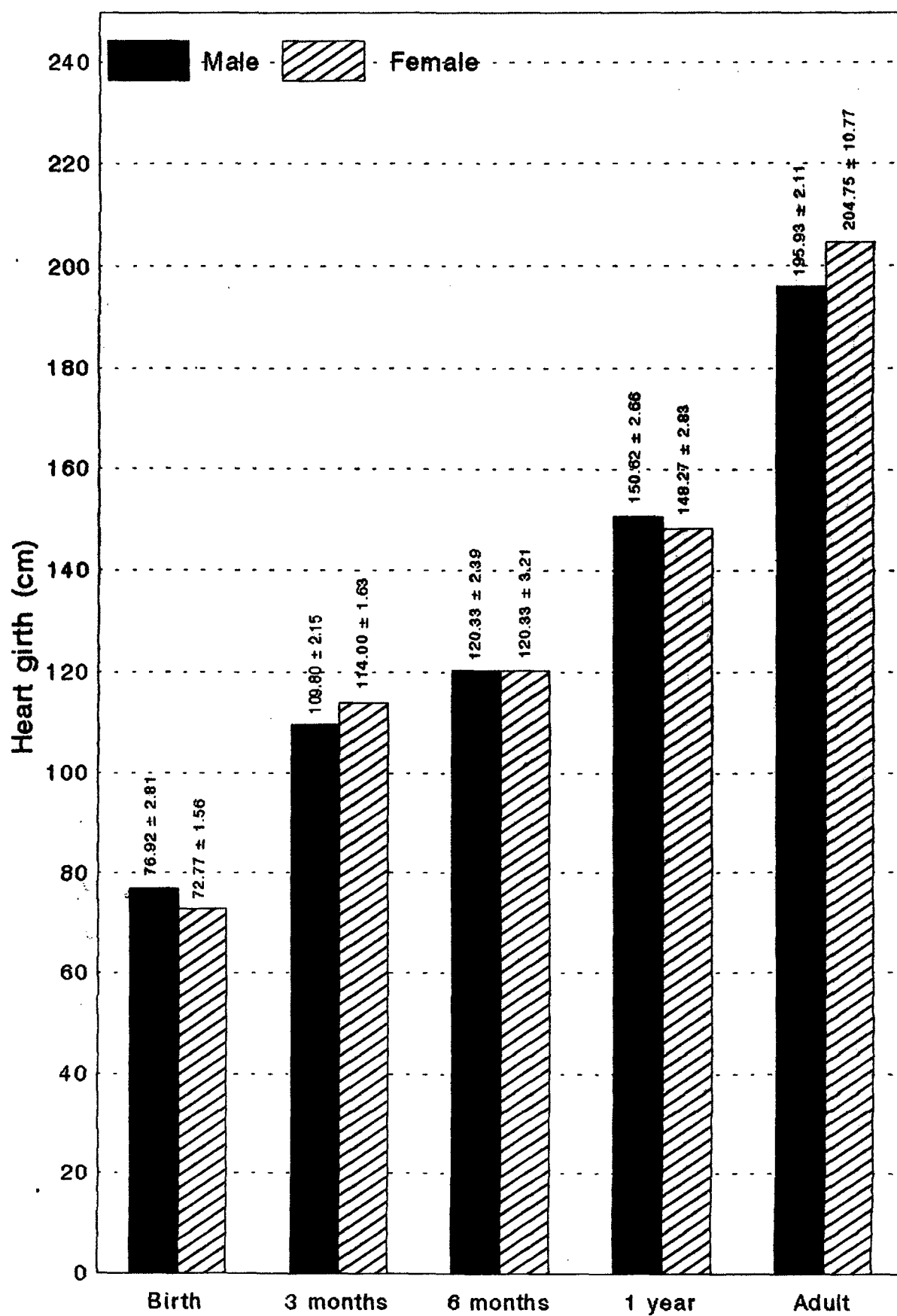
Average circumference of neck (at base) was 35.04 \pm 1.46 and 33.38 \pm 0.74 cm at birth, 64.21 \pm 1.48 and 59.77 \pm 1.40 cm at 1 year and 88.20 \pm 1.44 and 81.46 \pm 0.57 cm at adult age, respectively in male and female Kachchhi camels. The males were having significantly ($P < 0.05$) thicker necks at one year and adult age than those of the females. The thickness of neck of Kachchhi camel noticed during the investigation was lesser than that reported for Bikaneri, Jaisalmeri and Kachchhi camels by Anonymous (1992).

Table 4.2.3 Circumferences of important body parts in different age groups of Kachchhi camels

Measurements (cm)	Age group									
	Birth		3 months		6 months		1 year		Adult	
	Male (12)	Female (13)	Male (5)	Female (9)	Male (12)	Female (12)	Male (29)	Female (30)	Male (28)	Female (176)
Circumference of neck (at base)	35.84 ±1.46	33.38 ±0.74	44.68 ±1.12	46.44 ±0.96	45.92 ±1.59	46.33 ±0.92	64.21 ±1.48	59.77 [†] ±1.40	88.20 ±1.44	81.46 [†] ±0.57
Heart girth	76.92 ±2.81	72.77 ±1.56	109.88 ± 2.15	114.88 ± 1.63	120.33 ± 2.39	120.33 ± 3.21	150.62 ± 2.66	148.27 ± 2.83	195.93 ± 2.11	204.75 ±10.77
Body girth at hump	77.67 ±3.19	74.15 ±2.89	126.68 ± 4.34	133.44 ± 1.43	146.83 ± 3.75	151.88 ± 5.44	175.66 ± 2.98	180.17 ± 3.07	242.84 ± 7.49	245.24 ± 1.98
Circumference of hump at base	26.88 ±2.48	29.85 ±2.38	82.48 ±3.71	71.78 ±6.86	88.88 ±5.89	85.88 ±7.83	97.38 ±3.31	98.88 ±4.36	126.79 ± 3.98	127.33 ± 2.11
Circumference of foot pad										
(a) Foreleg	38.17 ±0.69	38.88 ±0.23	39.88 ±1.82	38.89 ±0.45	45.33 ±1.23	43.75 ±2.81	53.47 ±0.68	53.17 ±0.93	69.29 ±0.95	69.14 ±0.54
(b) Hindleg	27.54 ±0.66	27.88 ±0.28	35.68 ±0.93	34.33 ±0.88	40.17 ±0.98	39.88 ±1.84	48.88 ±0.78	47.77 ±1.12	62.18 ±0.88	59.98 [†] ±0.38
Diameter of chest pad										
(a) Verticle	8.21 ±0.31	7.54 ±0.27	11.68 ±0.75	12.33 ±0.52	13.92 ±0.42	13.67 ±0.47	15.91 ±0.27	15.48 ±0.34	19.96 ±0.24	19.68 ±0.18
(b) Horizontal	5.88 ±0.28	5.27 ±0.23	10.48 ±0.39	9.56 ±0.26	11.88 ±0.43	10.83 ±0.46	14.18 ±0.29	13.85 ±0.29	18.84 ±0.28	17.85 ±0.13
Diameter of fore foot pad										
(a) Verticle	10.29 ±0.28	9.92 ±0.21	12.48 ±0.24	12.33 ±0.28	14.42 ±0.43	13.83 ±0.42	16.87 ±0.23	15.89 ±0.31	21.36 ±0.48	20.94 ±0.18
(b) Horizontal	7.75 ±0.24	7.27 ±0.28	10.88 ±0.37	11.11 ±0.32	12.21 ±0.36	12.25 ±0.54	15.48 ±0.22	14.88 ±0.34	20.87 ±0.32	20.26 ±0.13
Diameter of rear foot pad										
(a) Verticle	9.54 ±0.38	9.38 ±0.35	11.48 ±0.24	11.39 ±0.16	11.92 ±0.36	12.21 ±0.59	14.76 ±0.27	14.43 ±0.27	18.57 ±0.34	18.94 ±0.14
(b) Horizontal	7.88 ±0.25	6.81 ±0.19	10.88 ±0.52	9.28 ±0.28	10.29 ±0.27	10.71 ±0.62	13.84 ±0.28	13.48 ±0.32	17.57 ±0.33	17.66 ±0.13

Figures in the parenthesis indicate the number of observations.
 * Sex differences significant for the trait in the age group
 (P < 0.05).

Figure 4.4 : Heart girth (cm) of Kachchhi Camel



Average circumference of hump at base was 26.08 ± 2.48 and 29.85 ± 2.30 cm at birth and 126.79 ± 3.90 and 127.33 ± 2.11 cm at adulthood, respectively in male and female Kachchhi camel. The hump size increased greatly during adulthood. The observation on circumference of hump at different ages were comparable in the two sexes.

Average circumferences of foot pad of fore leg was 30.17 ± 0.64 and 30.00 ± 0.23 cm at birth and 69.29 ± 0.95 and 69.14 ± 0.54 cm in adulthood, respectively in male and female Kachchhi camels. Similarly, circumferences of foot pad of hindleg was 27.54 ± 0.66 and 27.00 ± 0.28 cm at birth and 62.18 ± 0.88 and 59.98 ± 0.38 cm at adult age, respectively in male and female camels. Average diameter of chest pad (vertical) was 8.21 ± 0.31 and 7.54 ± 0.27 cm at birth and 19.96 ± 0.24 and 19.60 ± 0.18 cm in adulthood, respectively in male and female Kachchhi camels. Average diameter of chest pad (horizontal) was 5.88 ± 0.28 and 5.27 ± 0.23 cm at birth, and 18.04 ± 0.28 and 17.05 ± 0.13 cm in adulthood, respectively in male and female Kachchhi camels. Average vertical diameter of fore foot-pad was 10.29 ± 0.28 and 9.92 ± 0.21 cm at birth, and 21.36 ± 0.40 and 20.94 ± 0.10 cm at adulthood, respectively in male and female. Similarly, in the camels, horizontal diameter of fore foot-pad was 7.75 ± 0.24 and 7.27 ± 0.20 cm at birth and 20.07 ± 0.32 and 20.26 ± 0.13 cm at adulthood, respectively in male and female. Average vertical diameter of rear foot-pad was 9.54 ± 0.38 and 9.30 ± 0.35 cm at birth and 18.57 ± 0.34 and 18.94 ± 0.14 cm at adult age, respectively in male and female. Average horizontal diameter of

rear foot-pad was 7.08 ± 0.25 and 6.81 ± 0.19 cm at birth and 17.57 ± 0.33 and 17.86 ± 0.13 cm, respectively in male and female adult Kachchhi camels. The measurements of various foot-pad increased with increase in age of the animal. The sex was not having any significant ($P < 0.05$) effect on the measurements of various foot-pad at different ages, except on circumference of foot-pad in hindlegs and horizontal diameter of chest pad during adulthood in the Kachchhi camel. The fore feet were having larger foot-pad than hindleg in the Kachchhi camel. The observations on circumference of fore and hind foot-pad in the adult Kachchhi camel were in agreement with those of Anonymous (1992) in the breed kept at NRCC, Bikaner.

The study on biometry of the Kachchhi camel indicated that all the body measurements increase with growth of the animal without any significant effect of sex on them except at adulthood. At adult age some of the body measurements were larger in males than in females. In general, the Kachchhi camels are shorter in length and slightly lesser in height. They have moderate size of neck and head. The tails of Kachchhi camels are slightly shorter.

4.2.4 Relation between biometrical measurements

Correlation coefficients between height at various points as well as body circumference at birth and adult age are presented in Table 4.2.4.

Table 4.2.4 Coefficient of correlations between various body measurements at birth and adult age

		X1	X2	X3	<u>At birth</u>	X5	X6	X7	X8	X9	X10	X11
					X4							
Height at wither	X1	1.00										
Heart girth	X2	0.2329	1.00									
Body girth at hump	X3	0.0858	0.8625 [†]	1.00								
Height at shoulder joint	X4	0.3168	0.6796 [†]	0.8243 [†]	1.00							
Height at knee	X5	0.0969	0.5147 [†]	0.6195 [†]	0.6427 [†]	1.00						
Height at hump	X6	0.3319	0.1978	0.1126	0.2293	0.8476	1.00					
Height at highest point of hump	X7	0.7371 [†]	0.4767 [†]	0.4565 [†]	0.6473 [†]	0.4275 [†]	0.3779	1.00				
Height at hip joint	X8	0.6076 [†]	0.5494 [†]	0.5948 [†]	0.8379 [†]	0.4471 [†]	0.3181	0.7955 [†]	1.00			
Height at pin bone	X9	0.5699 [†]	0.4552 [†]	0.5161 [†]	0.8160 [†]	0.4344 [†]	0.2231	0.7458 [†]	0.9545 [†]	1.00		
Height at stifle	X10	0.3922	0.7089 [†]	0.7748 [†]	0.7095 [†]	0.4597 [†]	0.2648	0.5683 [†]	0.7131 [†]	0.6628 [†]	1.00	
Height at hock	X11	0.1454	0.6814 [†]	0.7625 [†]	0.5758 [†]	0.5034 [†]	0.0907	0.5012 [†]	0.3935	0.3824	0.5458 [†]	1.00
					<u>Adult age</u>							
Height at wither	X1	1.00										
Heart girth	X2	0.0584	1.00									
Body girth at hump	X3	0.1749 [†]	0.8400	1.00								
Height at shoulder joint	X4	0.4087 [†]	0.8221	0.8678	1.00							
Height at knee	X5	0.1520 [†]	0.0517	0.0172	0.3832 [†]	1.00						
Height at hump	X6	0.1601 [†]	0.0676	0.3674 [†]	0.0440	0.0282	1.00					
Height at highest point of hump	X7	0.3308 [†]	0.0500	0.2716 [†]	0.3089 [†]	0.2894 [†]	0.2559 [†]	1.00				
Height at hip joint	X8	0.2756 [†]	0.0846	0.2172 [†]	0.5000 [†]	0.4742 [†]	0.0870	0.7042 [†]	1.00			
Height at pin bone	X9	0.2782 [†]	0.0830	0.2284 [†]	0.4915 [†]	0.4708 [†]	0.1057	0.7137 [†]	0.9728 [†]	1.00		
Height at stifle	X10	0.2617 [†]	0.0138	0.2367 [†]	0.4008 [†]	0.4776 [†]	0.1854 [†]	0.5538 [†]	0.7061 [†]	0.6977 [†]	1.00	
Height at hock	X11	0.1404 [†]	0.1134	0.0495	0.1979 [†]	0.2542 [†]	0.0180	0.3098 [†]	0.4264 [†]	0.4545 [†]	0.2956 [†]	1.00

* significant ($P < 0.05$)

All the correlation coefficient between height of important body points as well as chest and body girths were positive at birth in Kachchhi camel. Most of the correlations of chest and body girths and height at shoulder and knee with other body measurements were significant ($P < 0.05$). This study indicated that there was concomittant increase or decrease in heights measured at various body points and circumferences measured at chest and hump.

Most of the correlation coefficients worked out between heights of important body points as well as chest and body girth were positive at adult age in the Kachchhi camels. The association of height at withers, height at highest point of hump, height at shoulder as well as knee with most of the body measurements were positive and significant ($P < 0.05$). This indicated that with the increase in these measurements, there was increase in the rest of the body measurements and vice-versa. This indicated that the height at wither or hump is a good indicator of growth of the animal.

4.3 BODY WEIGHT

Adult body weights of 28 male and 176 female Kachchhi camels were estimated from the heart girths of the animals using prediction-equation given by Khanna *et al.* (1990b). The average estimated adult body weights of the Kachchhi camels is presented in Table 4.3.1.

Table 4.3.1 Estimated adult body weight of Kachchhi camel (kg)

Taluka	Male	Female
Lakhapat	422.74 ±15.71 (10)	428.91 ± 6.66 (66)
Bhuj	430.76 ±15.03 (10)	425.28 ± 9.19 (50)
Rapar	480.71 ±17.64 (8)	433.50 ± 6.99 (80)
Pooled	436.45 ±15.97 (28)	429.45 ± 7.58 (176)

Figures in parenthesis indicate number of observations.

On an average body weight of adult Kachchhi camel was comparable in male (436.45 ± 15.97 kg) and female (429.45 ± 7.58 kg). The effect of location was also non-significant. The estimated body weight of Kachchhi camel in the present investigation is lower than average body weight of Kachchhi camel recorded by Anonymous (1987 and 1992). This might be due to error in estimation using prediction-equation evolved for the other herd. Therefore, there is need for recording actual body weight of Kachchhi camels and evolving suitable prediction equation for field use.

4.4 REPRODUCTION IN CAMEL

Age at which camels are mated first time, age at first calving and calving interval are important parameters for

efficiency of reproduction. Knowledge on breeding season and signs of oestrus, pregnancy and parturition will aid in better care and management to enhance reproductive efficiency. Informations on age at first service, breeding season, signs of oestrus, pregnancy and parturition were collected through survey in the breeding tract of Kachchhi camel using appropriate questionnaire. In addition to this data on age at first calving, calving interval and seasonality in calving were collected from the records available at Government Camel Breeding Farm, Dhori (Kachchh).

4.4.1 Age at first service

4.4.1.1 Females

Average age at first service in she-camels of Kachchhi breed as observed by herds-men is presented in Table 4.4.1.

Table 4.4.1 Average age at first service in she-camels

Taluka	Age at first service as observed by herds men					
	<u>3 years</u>		<u>4 years</u>		<u>5 years</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	23	95.83	1	4.17	0.00	0.00
Bhuj (25)	10	40.00	15	60.00	0.00	0.00
Rapar (25)	13	52.00	11	44.00	1	4.00
Pooled (74)	46	62.16	27	36.49	1	1.35

Figures in the parenthesis indicate number of observations.

Most of the herds men surveyed in the Kachchh district observed age at first service of three years (62.16%) followed by that of 4 years (36.49%) in the female Kachchhi camels. Only one (1.35%) herd-man observed age at first service of five years in the Kachchhi camel. Majority (95.83%) of herds in Lakhapat taluka and about 52 per cent herds of Rapar taluka had average age at first service of 3 years. In contrast to this, 60 per cent herds of Bhuj taluka had average age at first service of 4 years. The feed resources available and breeding management might have played major role in the variation in age at first service of camels from different talukas.

Anonymous (1992) reported average age at first service to be around 3 years in Kachchhi camels and around 4 years in Bikaneri and Jaisalmeri camels maintained at NRCC, Bikaner. This report confirmed the findings of Khanna *et al.* (1990b) in Bikaneri and Jaisalmeri camels. Thus the results of present survey showing average age at first service of 3 to 4 years in Kachchhi female camels are in accordance to the findings of earlier workers.

4.4.1.2 Males

Average age at first breeding in male camels of the Kachchhi breeds as observed by herds men of the Kachchh district is presented in Table 4.4.2.

Table 4.4.2 Average age at first breeding in male camels

Age at first breeding as observed by herds men						
Taluka	<u>4 years</u>		<u>5 years</u>		<u>6 years</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	23	95.83	1	4.17	0.00	0.00
Bhuj (25)	18	72.00	7	28.00	0.00	0.00
Rapar (25)	1	4.00	24	96.00	0.00	0.00
Pooled (74)	42	56.76	32	43.24	0.00	0.00

Figures in the parenthesis indicate number of observations.

The herds men of Kachchh put their male camels for breeding first time at age of 4 years (56.76%) or 5 years (43.24%). The herds men of Lakhapat taluka put their male camels to first breeding mostly (95.83%) at the age of 4 years, whereas, the herds men of Rapar taluka mostly (96.00%) put their male camels to first breeding at the age of 5 years. Almost 72 per cent herds men of Bhuj taluka could put their male camels to breeding first time at the age of 4 years and remaining herds men were following age at first breeding at 5 years. There was a tendency to breed male as well as female camel at an earlier age in the Lakhapat taluka as compared to that in the other places in the Kachchh.

Khanna *et al.* (1987) noticed initial sexual desire at 3 to 4 years of age and normal rutting at 5 to 6 years of age in Bikaneri male camels. Khan and Kohli (1972) noticed average

rutting age of 6 years in Dromedaries. Thus, the age at first breeding of 4 to 5 years followed for male Kachchhi camels in their home tract is quite satisfactory. A Kachchhi male camel in 'rut' is shown in Plate VII.

The ratio of male to females followed by traditional breeders of Kachchhi camels is depicted in Table 4.4.3.

Table 4.4.3 Ratio of male to females in Kachchhi camels

Taluka	Male:Female ratio followed by traditional breeders							
	<u>1:40-50</u>		<u>1:50-70</u>		<u>1:70-100</u>		<u>1:>100</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	5	20.83	9	37.50	1	4.17	9	37.50
Bhuj (25)	7	28.00	11	44.00		0.00	7	28.00
Rapar (25)	3	12.00	15	60.00	1	4.00	6	24.00
Pooled (74)	15	20.27	35	47.30	2	2.70	22	29.73

Figures in the parenthesis indicate number of observations.

About 47 per cent traditional Kachchhi camel breeders allotted 50 to 70 females to one breeding male. Surprisingly, about 30 per cent traditional breeders had one male for more than 100 breedable females. About 20 per cent traditional breeders had one male for breeding 40 to 50 female camels. The herds from different talukas were having more or less same trend in proportion of male to females.

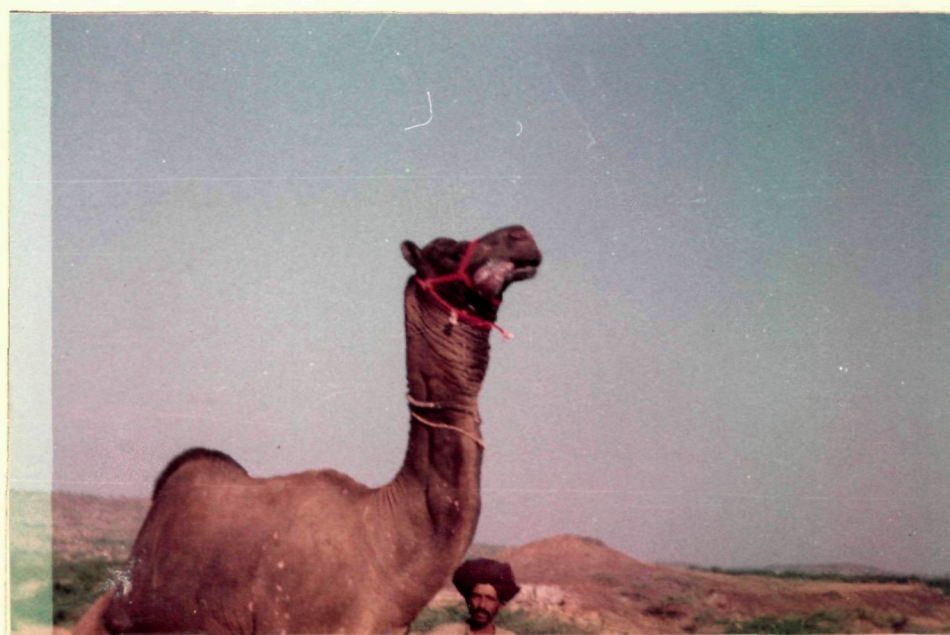


Plate VII : A typical rutting male camel.

The ideal ratio of male to female camels suggested by different research workers is to be 1:30-50 (Singh, 1966); 1:40-50 (Schwartz, 1992) and 1:50-70 (Matharu, 1966 and Leupold, 1986). However, Khanna *et al.*(1987) recommended a ratio of 1 to 20-25 females under Indian condition.

From the foregoing it can be concluded that the traditional camel breeders of Kachchh district should increase number of males in their herd. The lower proportion of males in the herds is likely to reduce their body condition and thereby will adversely affect their breeding performance. Provision of extra male is also desirable for having better genetic diversity and avoiding inbreeding.

4.4.2 Breeding season

During the survey work all the 74 camel owners opined that winter is the only breeding season for Kachchhi camels in the home tract. This is in conformation to the reports of Singh and Prakash (1964), Matharu (1966) and Khanna *et al.*(1990b) who reported winter (November to February or March) as a main breeding season for Indian camels.

Data on 481 calvings from 1986 to 1995 were collected from the records of Government Camel Breeding Farm, Dhori (Kachchh). Monthwise distribution of calving in the Kachchhi camel of the farm is presented in Table 4.4.4 and Fig.4.5.

Figure 4.5 : Monthwise distribution of calving
in Kachchhi Camel

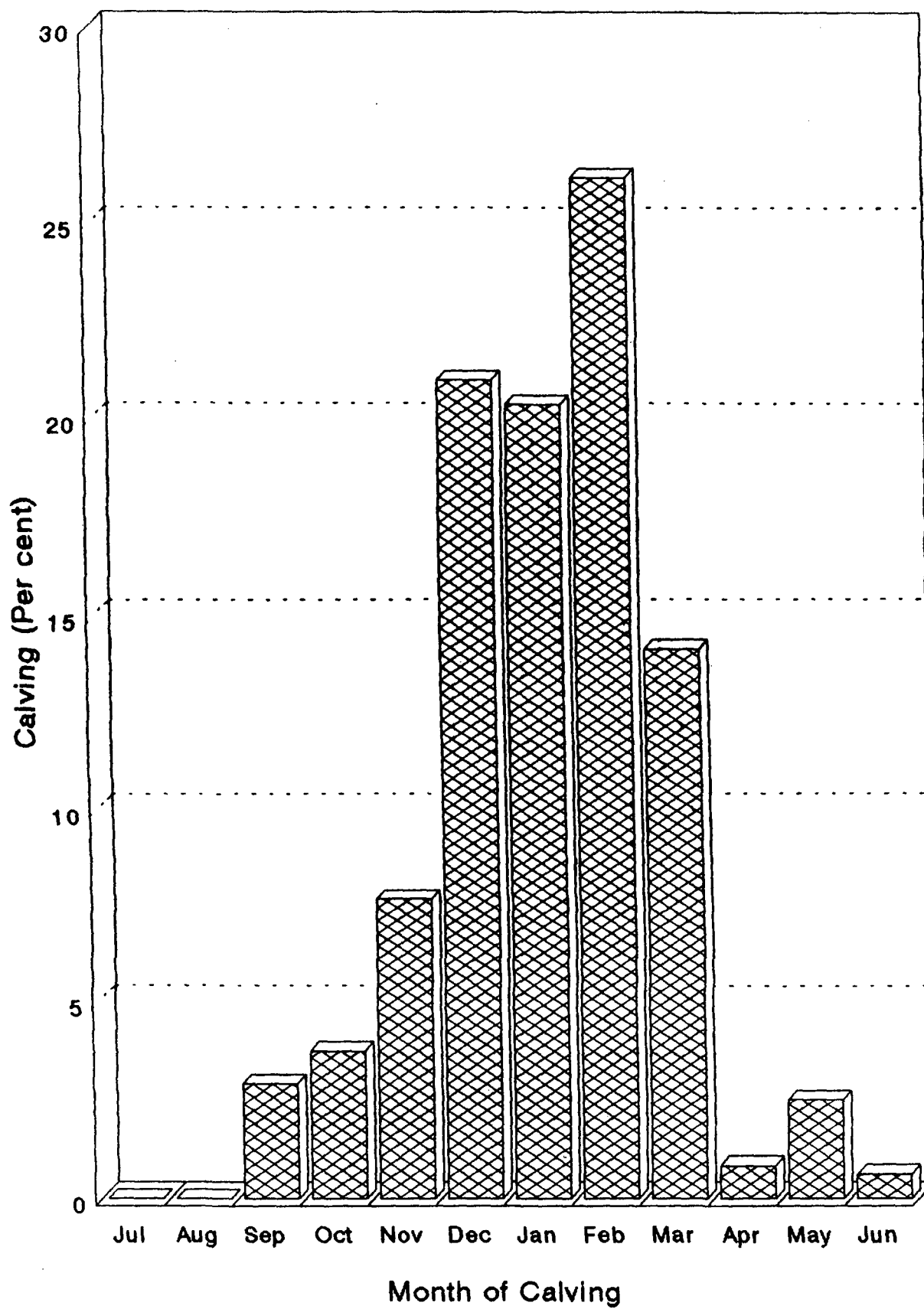


Table 4.4.4 Monthwise distribution of calving in Kachchhi camels

Month	Number of calvings	Calving per cent
July	0	0.00
August	0	0.00
September	14	2.91
October	18	3.74
November	37	7.69
December	101	21.00
January	98	20.37
February	126	26.20
March	68	14.14
April	4	0.83
May	12	2.50
June	3	0.62
Total	481	100.00

The perusal of the results indicated that majority (81.71%) of the calvings were distributed from December to March with no calving during July-August and very low frequency (18.29%) of calving during rest of the months. This is in accordance to the breeding season observed by the traditional Kachchhi camel breeders, which is mostly during winter months resulting into calving season in mid to late winter. Khanna *et al.* (1990b) also reported calving season from December to March in Bikaneri camels in Rajasthan.

4.4.3 Signs of oestrus

Of 74 herds of Kachchhi camels surveyed, the detection of oestrus (heat) in females was mostly (88 per cent) through the stud camel without major difference in the herds of three talukas. Only 12 per cent herds men were able to identify oestrus through external symptoms. According to them, they were identifying the oestrus mostly from chasing of she-camel to a young male in the herd. The female was used to play and beat the young male in the herd. In very few cases, they observed vaginal mucus discharge in she-camel during oestrus. Thus, presence of a stud camel was necessary in the herd for detection of oestrus.

Chowdhary (1986a) also reported that females in oestrus goes to male. He also emphasised importance of male camel in heat detection. Plate VIII depicts courtship in Kachchhi camel before mating. Plate IX is showing characteristics postures while mating in Kachchhi camels.

About 66 per cent of the herds men surveyed, opined that their female camels returned to oestrus, if not pregnant, within third week of last oestrus or mating. Remaining 34 per cent of the herds men believed that their non-pregnant female camels returned to oestrus, during fourth week of earlier mating. The variation in the observation of the herds men for re-occurrence of oestrus might be due to acyclicity in she camel and absence of records. However, Joshi *et al.* (1978) reported length of oestrous cycle between 21-24 days.



Plate VIII: Courtship in Kachchhi camels before mating.

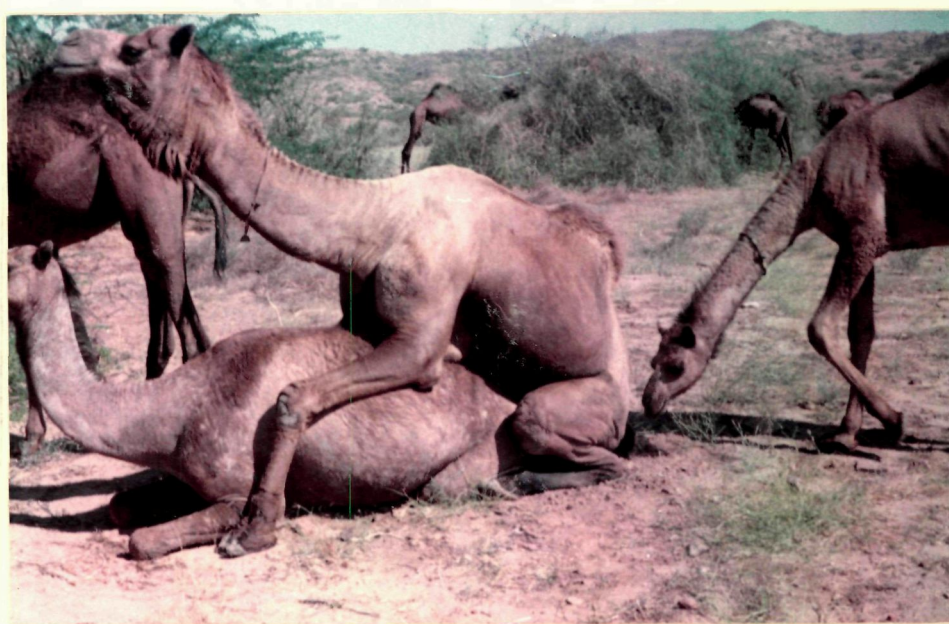


Plate IX : Mating in Kachchhi camels.

4.4.4 Signs of pregnancy

When a pregnant female camel is approached by male, she is lifting her tail in a typical fashion (cocking of tail) and holding in the position. This is observed as the earlier signs of pregnancy by the traditional camel breeders in India. The traditional Kachchhi camel breeders were asked how much earlier they can detect pregnancy in camel by this sign. The results on stage of early pregnancy when cocking of tail was observed by them, is presented in Table 4.4.5.

Table 4.4.5 Cocking of tail as the earliest sign of pregnancy observed by camel breeders

Taluka	Cocking of tail observed after conception					
	After 10 days		After 15 days		After 30 days	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	3	12.50	21	87.50	0.00	0.00
Bhuj (25)	4	16.00	20	80.00	1	4.00
Rapar (25)	3	12.00	22	88.00	0.00	0.00
Pooled (74)	10	13.51	63	85.14	1	1.35

Figures in the parenthesis indicate number of observations.

The cocking of tail was observed as the earliest sign of pregnancy by all the traditional camel breeder of Kachchh district (Plate X). Around 85 per cent of the camel breeders could detect conception in she-camel through this sign after 15 days of service. The camel breeders of all the three talukas were

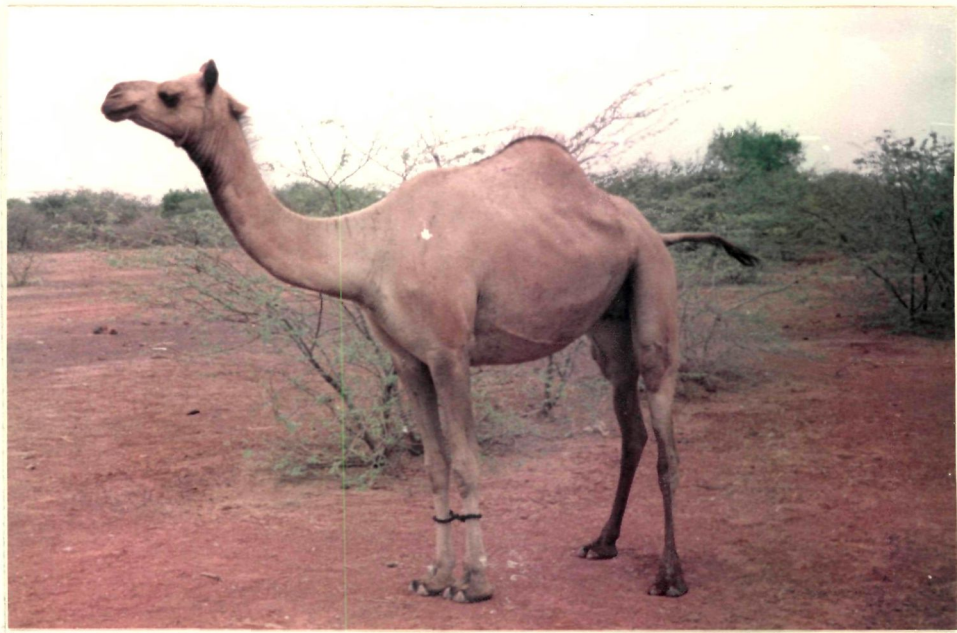


Plate X: A pregnant she-camel

having same confidence. Few of the camel breeders (13.51%) could detect pregnancy as early as 10 days of conception from this sign. However, conversations with the herds men revealed that commonly younger camels were showing this behaviour sign earlier than the older ones. Singh (1966) and Rathore (1988) also reported this behavioural sign after 15 to 20 days of conception. Chowdhary (1988a) reported feasibility of detecting conception through this sign as early as 7 to 15 days.

4.4.5 Age at first calving

A small herd of Kachchhi camel is maintained at Government Camel Breeding Farm, Dhori (Kachchh). Analysis of the data available on 42 camel heifers indicated that the Kachchhi camels were having average age at first calving of 1932.47 ± 48.52 days. Looking to the age at first service (3 to 4 years) followed by the traditional camel breeders of the Kachchh, the average age at first calving recorded at farm seems to be on slightly higher side.

Anonymous (1990) and Khanna *et al.* (1990b) reported that average age at first calving ranging from 1489 to 1882 days in native breeds of camel at NRCC, Bikaner. This suggested that feeding and management may be improved to lower age at first calving for Kachchhi camel at the Government Camel Breeding Farm, Dhori (Kachchh).

4.4.6 Calving interval

Data on calving of 28 Kachchhi camels were available at Government Camel Breeding Farm, Dhori (Kachchh). On an average the camel calved at a interval of 819.92 ± 36.00 days. This value is on higher side than the average calving interval (738.40 days) reported for Kachchhi camels by Anonymous (1982). Average calving interval of 771.66 days was observed in Bikaneri camels (Khanna *et al.*, 1990b).

The 74 traditional Kachchhi camel breeders were asked for number of calving and number of breedable she-camels they had during previous year. The data so collected indicated that there were 36.21 per cent calving in 1740 breedable she-camels owned by the breeders of three talukas. Khanna *et al.* (1987) reported calving rate of 39.20 per cent in breedable Bikaneri camels.

4.4.7 External signs of approaching parturition

All the 74 herds men keeping Kachchhi camel were inquired for external signs of approaching parturition, they know. The results are presented in Table 4.4.6.

Most of the herds men (81.08%) noticed that she-camel gets isolated from the herd when parturition is approaching. Good number of herds men observed udder enlargement (59.46%) and engorgement^s of teats (55.41%), when parturition was approaching in the Kachchhi camels (Plate XI). Uneasiness and off-feed were rarely observed (10.81%) just before parturition in the Kachchhi camels by the herds men. Only one herd man (1.35%) was not



Plate XI : Engorgement of udder and teats before parturition.

knowing any external sign indicating parturition in the camels. The traditional breeders of Kachchhi camel thus have good knowledge on external signs of approaching parturition. The signs observed by them were also noticed by Prakash and Singh (1962) and Khanna et al. (1987) in camels. It can be concluded that getting isolated from the herds with udder and teat engorgement⁹ are common and reliable signs for approaching parturition in the Kachchhi camel.

Table 4.4.6 External signs of approaching parturition in Kachchhi camels

Taluka	External signs of parturition as observed by herds men									
	<u>Runaway from the herd</u>		<u>Udder enlargement</u>		<u>Teat engorgement⁹</u>		<u>Off-feed with uneasiness</u>		<u>Not known</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	23	95.83	11	45.83	9	37.50	3	12.50	1	4.17
Bhuj [^] (25)	20	80.00	13	52.00	16	64.00	4	16.00	0	0.00
Rapar (25)	17	68.00	20	80.00	16	64.00	1	4.00	0	0.00
Pooled (74)	60	81.00	44	59.46	41	55.41	8	10.81	1	1.35

Figures in the parenthesis indicate number of observations.

4.5 MILK PRODUCTION

4.5.1 Milk yield

Daily milk yield of Kachchhi camel obtained by the traditional breeders in the three talukas of the Kachchh is presented in Table 4.5.1.

Almost equal number of the traditional camel breeders obtained daily milk yield of 3 to 4 litres (35.62%) and 4 to 5 L (34.24%) from the Kachchhi camel. About 11 per cent of camel breeders could get daily milk of 5 to 6 L per head, from their camels. A few (16.44%) camel breeders were hardly getting 2 to 3 L of milk daily per camel. The camel breeders of Bhuj taluka were reported lower milk yield than camels of other two talukas.

Table 4.5.1 Daily milk yield of Kachchhi camels obtained by traditional breeders

Taluka	Milk production (Litre)									
	2 - 3		3 - 4		4 - 5		5 - 6		≥ 6	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	3	12.50	8	33.33	9	37.50	3	12.50	1	4.17
Bhuj (25)	6	24.00	7	28.00	7	28.00	4	16.00	1	4.00
Rapar (24)	3	12.50	11	45.83	9	37.50	1	4.17	0	0.00
Pooled (73)	12	16.44	26	35.62	25	34.24	8	10.96	2	2.74

Figures in the parenthesis indicate number of observations.

Actual milk yield was recorded in morning, afternoon and evening to arrive at daily milk yield of 24 Kachchhi camels, maintained at Government Camel Breeding Farm, Dhori (Kachchh). Average daily milk yield of the Kachchhi camel so recorded was found to be 5.52 ± 0.29 L with range of 3.5 to 7.40 L, during fourth to sixth month of lactation.

Anonymous (1992) recorded 4 to 10 L and Kohler-Rollefson (1992) observed 2 to 6 L of daily milk yield in Kachchhi camels kept by the traditional camel breeders in the Kachchh district. The Kachchhi camels were yielding on an average 5.2 to 14.6 L of milk daily at NRCC, Bikaner.

Kachchhi camels have good milk production potential. They can be developed as dairy animals in the arid climate of Kachchh. There is urgent need to explore network of Kachchh dairy for procurement of camel milk. Feasibility of processing camel milk needs to be studied scientifically.

4.5.2 Traditional milking practices and milk disposal

During the survey it was observed that the camels were milked as and when required by the breeders. However, as a common practice the Kachchhi camels were milked thrice a day. The milking was done in standing position (Plate XII) after allowing the calf to suckle. The milkers were either milking with one hand or with both the hands while resting the vessel on their raised knee.

The traditional camel breeders allow the calf to suckle sufficient milk throughout the lactation. The milk obtained after calf suckling is utilised by their families for drinking purpose and making tea. Many a time while migration, the camel milk is only source of food and water. Occasionally they prepare a sweat locally known as *khir*. The camel herds are brought in vicinity of their villages on social function to have camel milk to entertain



Plate XII: Milking of camel in standing position.

their guests. The milk is never boiled or processed. The milk is not sold due to religious taboo and social ban. The traditional camel breeders, therefore, need to be educated against their superstitious and believes. In fact sell of milk can be a good source of income for them.

Kohler-Rollefson (1992) also observed that the traditional Kachchhi camel breeders sometimes subsisted for weeks on milk of camels.

4.5.3 Gross composition of milk

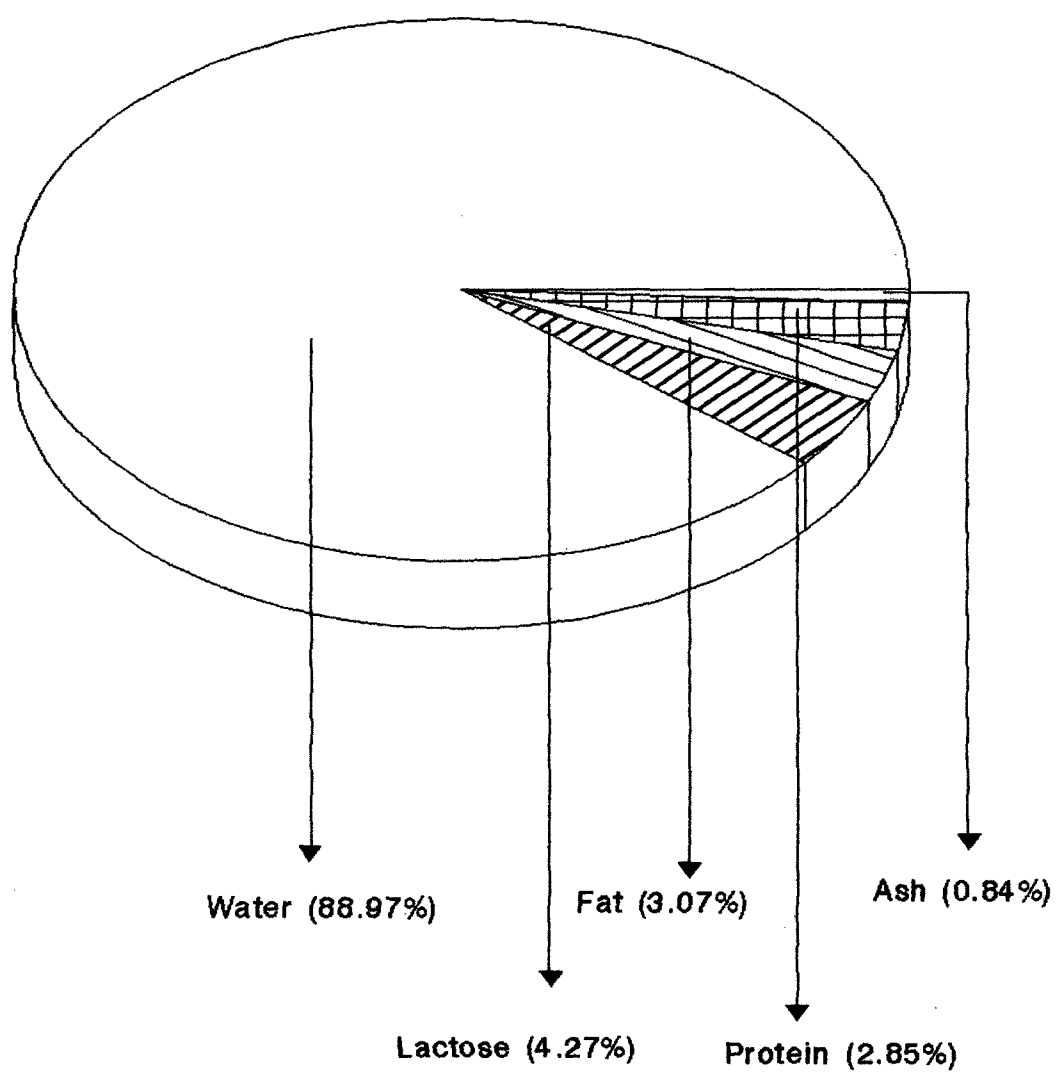
Camel milk remains an important component of daily diet for traditional camel breeders in India. It is nearly balanced diet supplying major nutrients. To study gross composition of milk from Kachchhi camels, 21 samples from different animals were analysed. Average composition of milk from the Kachchhi camel is depicted in Table 4.5.2 and Fig.4.6.

Table 4.5.2 Gross chemical composition (%) of milk from Kachchhi camel

Constituent	Range	Average
Total solids	8.99 to 13.87	11.24 \pm 0.32
Fat	2.00 to 4.35	3.07 \pm 0.14
Solids not fat*	6.70 to 10.59	8.17 \pm 0.24
Protein	2.14 to 3.75	2.85 \pm 0.25
Lactose	3.89 to 4.76	4.27 \pm 0.04
Ash	0.68 to 1.13	0.84 \pm 0.03
Specific gravity	1.020 to 1.030	1.024 \pm 0.00

* Solids not fat calculated by difference.

**Figure 4.6 : Chemical composition of milk
from Kachchhi Camel**



Perusal of data given in Table 4.5.2 indicated that Kachchhi camel milk was found to contain 11.24 ± 0.32 per cent total solids, 3.07 ± 0.14 per cent fat, and 8.17 ± 0.24 per cent solids not fat. The solids not fat was largely constituted by 2.85 ± 0.25 per cent protein, 4.27 ± 0.04 per cent lactose and 0.84 ± 0.03 per cent ash. The Kachchhi camel milk had specific gravity of 1.024 ± 0.00 . Thus composition of milk from the Kachchhi camel did not differ much from that of milk from Indian camel breeds as reported by Ohri and Joshi (1961), Desai *et al.* (1982) and Khanna *et al.* (1980b). However, camel milk seems to have lower fat and solids not fat contents than the cow milk.

4.8 CAMEL HAIR AND UTILITY

As a common practice traditional camel breeders were shearing hair coat of their camels after Holi festival (March). Generally the hair coat of head, neck and hump was not clipped. The shorn hair coat was generally blended with cotton or goat hair for preparing articles for their daily use. The family members of traditional camel breeders in the Kachchh have skill to prepare articles like ropes, net for udder (*vano*), purses, etc. (Plate XIII).

Personal conversation with the traditional camel breeders in Kachchh indicated that on an average 0.5 g to 1 kg of hair was produced annually per head. None of the camel breeder was weighing and keeping record on hair production. The hair so produced was never sold. It was only used for preparing articles for their domestic use.

131a



Plate XIII: Articles prepared from camel hair and its blend.

4.7 MODEL CHROMOSOMAL PROFILE

The metaphase spread prepared by short-term blood culture from male and female Kachchhi camels are presented in Plate XIV and XV. The Giemsa stained karyotypes from male and female Kachchhi camels are presented in Plate XVI and XVII. In present study the deploid chromosome number in Kachchhi camel were found to be 74, this included 31 pairs of acro-centric chromosomes and 5 pairs of (16, 17, 22, 24 and 30) submetacentric chromosomes. The X chromosome was also submetacentric and Y chromosome was also found to be submetacentric. The Y chromosome was close to autosomes paired 32-33. Vijh *et al.* (1989) had also reported similar karyotype in Kachchhi camel except that Y chromosome they reported was acrocentric.

4.8 TRADITIONAL CAMEL MANAGERMENTAL PRACTICES

Traditional camel breeders of Kachchh should be complimented for development and preservation of Kachchhi camel breed. With help of personal interviews and preset questionnaire traditional camel managerial practices and socio-economic aspects were surveyed for 74 camel breeders from Lakhapat, Bhuj, and Rapar talukas of the Kachchh district.

4.8.1 Traditional camel breeders

Almost all the traditional Kachchhi camel breeders are maintaining camels as their ancestral livelihood. The major social group of traditional camel breeders in the three talukas of Kachchh are presented in Table 4.8.1.



Plate XIV : Metaphase spread from male Kachchhi camel (Giemsa stained X10000)

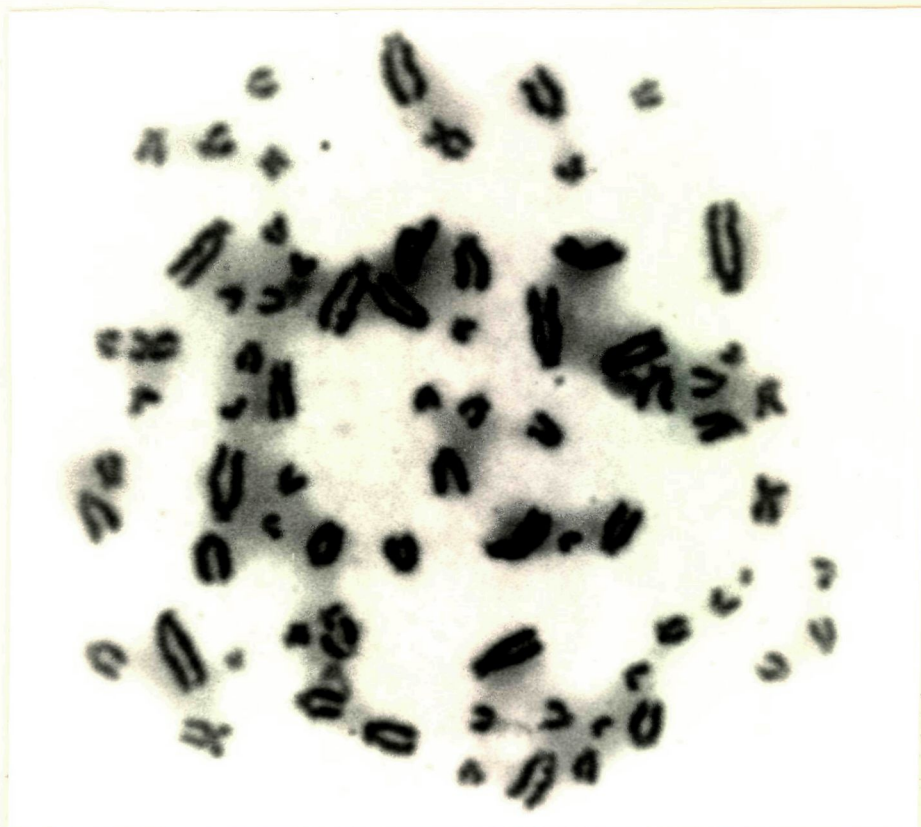


Plate XV : Metaphase spread from female Kachchhi camel. (Giemsa stained X10000)



Plate XVI : Karyotype prepared from male Kachchhi camel. (Giemsa stained X1000)



Plate XVII : Karyotype prepared from female Kachchhi camel. (Giemsa stained X1000)

Table 4.8.1 Social groups of traditional Kachchhi camel breeders

Taluka	<u>Rabari</u>		<u>Rajput</u>		<u>Mohammedan</u>		<u>Schedule cast</u>		<u>Total</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	17	70.83	1	4.17	6	25.00	0	0.00	24	100.00
Bhuj (25)	16	64.00	2	8.00	6	24.00	1	4.00	25	100.00
Rapar (25)	25	100.00	0	0.00	0	0.00	0	0.00	25	100.00
Pooled (74)	58	78.38	3	4.05	12	16.22	1	1.35	74	100.00

The survey indicated that Rabaries were the major (78.38%) camel breeders in the Kachchh. Camel breeders of Rapar taluka were belonging to only Rabari community. About 4 per cent of the traditional camel breeders in Kachchh were Rajput. About 16 per cent traditional camel breeders in the district belonged to Mohammedan, mostly migrated from Pakistan. Few Rajput family might have also migrated from Pakistan. Traditionally about 25 per cent camel breeders of Lakhapat and Bhuj belonged to Mohammedan community. Very interestingly one schedule caste family in Bhuj taluka had adopted camel breeding as a livelihood.

Anonymous (1992) also reported that 80 per cent camel population in Kachchh district was maintained by Rabaries. Khanna (1990) and Kohler-Rollefson (1992) had also identified 'Raikas' - Rabaries as the major community specialised in camel breeding in Western India. They also recorded that few Rajputs and Mohammedan also breed camels traditionally. These reports are in accordance to the findings of the present investigation.

Average family size of Kachchhi camel breeders was of 6.76 ± 0.35 persons (Table 4.8.2). The family constituted 2.28 ± 0.17 adult male, 1.95 ± 0.13 adult female and 2.52 ± 0.19 children. The family structure of the camel breeders was more or less similar in all the three talukas of the district. Thus the traditional camel breeders were having ideal family structure and size.

Table 4.8.2 Family size of Kachchhi camel breeders

Taluka	Adult male	Adult female	Children	Total
Lakhapat (24)	2.17 ± 0.23	1.90 ± 0.17	2.33 ± 0.24	6.38 ± 0.40 (24)
Bhuj (25)	2.52 ± 0.35	2.04 ± 0.24	3.36 ± 0.39	7.92 ± 0.78 (25)
Rapar (25)	2.16 ± 0.27	1.92 ± 0.25	1.88 ± 0.28	5.96 ± 0.49 (25)
Total (74)	2.28 ± 0.17	1.95 ± 0.13	2.52 ± 0.19	6.76 ± 0.35 (74)

Figures in the parenthesis indicate families surveyed

From the survey it was revealed that about 69 per cent of the traditional Kachchhi camel breeders were having their own 'pakka' houses. The pakka house was generally built from stones or bricks with lime or mud. About 31 per cent of the camel breeders in Kachchh were having their own hut like 'kachcha' houses. Generally the female members and children were used to stay at the house. One or two adult male members accompanied their camel herds during grazing. Very few (4%) traditional camel breeders hired paid male labour(s) for their help during migration.

Most (96%) of the traditional Kachchhi camel breeders were illiterate. Very few traditional camel breeders had education either upto primary (2.70%) or secondary (1.35%) school level. This might be coming in the way of their upliftment. The illiteracy might be one of the constraint in adopting scientific innovation in camel rearing. It is high time that government and non-government organisation should take interest in initiating the children of the camel breeder to take literal education.

Classification of the camel breeders as per their occupation is given in Table 4.8.3.

Table 4.8.3 Classification of camel breeders as per their occupation

Taluka	Occupation			
	<u>Only Animal Husbandry</u>		<u>Agriculture and Animal Husbandry (mixed farming)</u>	
	Frequency per cent		Frequency per cent	
Lakhapat (24)	13	54.17	11	45.83
Bhuj (25)	7	28.00	18	72.00
Rapar (25)	18	72.00	7	28.00
Pooled (74)	38	51.35	36	48.65

Figures in parenthesis indicate families surveyed.

Animal Husbandry was the major occupation for the traditional camel breeders of Lakhapat (54.17%) and Rapar

(72.00%) talukas. Whereas, majority (72.00%) of the traditional camel breeders of Bhuj taluka were following mixed farming. Thus for about 51 per cent of the traditional Kachchhi camel breeders, Animal Husbandry was the only source of income.

Land holding by the Kachchhi camel breeders in the different talukas is presented in Table 4.8.4 and Figure 4.7.

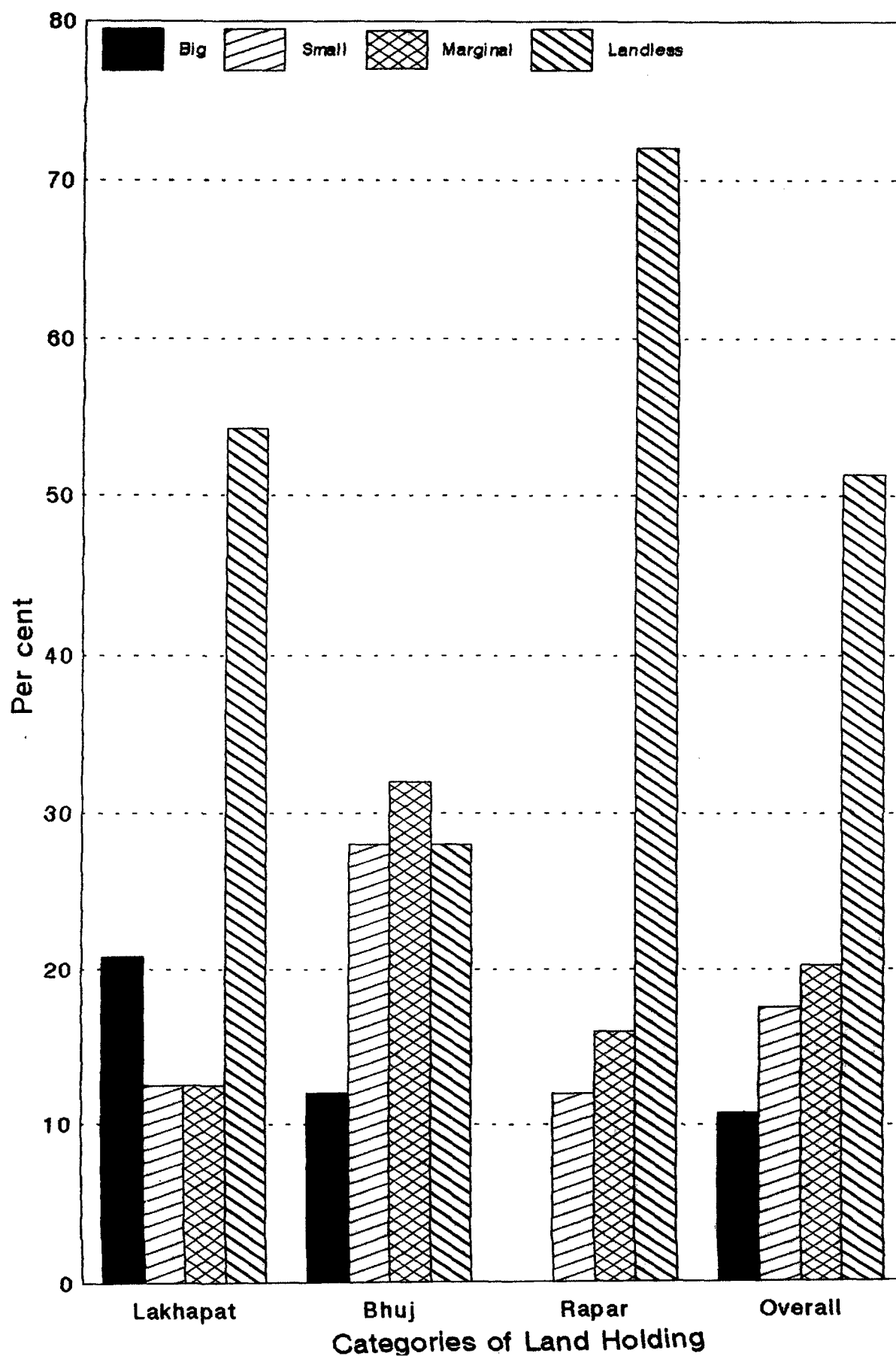
Table 4.8.4 Land holding by the Kachchhi camel breeders

Taluka	Class of the farmers							
	<u>Big farmers</u>		<u>Small farmers</u>		<u>Marginal farmers</u>		<u>Landless</u>	
	(Land more than 17.5 acre)		(17.5 acre land holding)		(7.5 acre land holding)			
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	5	20.83	3	12.50	3	12.50	13	54.17
Bhuj (25)	3	12.00	7	28.00	8	32.00	7	28.00
Rapar (25)	0	00.00	3	12.00	4	16.00	18	72.00
Pooled (74)	8	10.81	13	17.57	15	20.27	38	51.35

Figures in the parenthesis indicate number of observations.

About 49 per cent traditional Kachchhi camel breeders were holding land and following mixed farming. According to land holding by the Kachchhi camel breeders, 10.81 per cent were big farmers, 17.57 per cent were small farmers and 20.27 per cent were marginal farmers. Land holding was higher by the camel breeders of Lakhapat than those of Bhuj and Rapar talukas.

Figure 4.7 : Land Holding by Kachchhi Camel Breeders



It will be interesting to note that many of the traditional camel breeders in the district had appreciable land holding. Kohler-Rollefson (1992) pointed out that the socio-economic frame work of camel breeders in Rajasthan was undergoing substantial transformation. The camel breeding caste of the Raikas were gradually being forced out of their traditional occupation because of their landlessness.

The present survey also indicated that about 72 per cent of the traditional Kachchhi camel breeders were keeping only camels in their herds. Around 29 per cent of the traditional camel breeders were having other livestocks along with camels in their herds. The camel breeders, keeping other livestocks in their herds, were generally preferring to have sheep and goats over cattle and buffaloes. The pattern of livestock holding by the camel breeders was more or less similar in the three talukas surveyed.

All the traditional camel breeders were inquired for their annual income. They were reluctant, and rather not sure about information on their family income. As a rough estimate annual income from camels per family was upto Rs.5,000 for 39.19 per cent, Rs.5,000 to 10,000 for 35.14 per cent and more than Rs. 10,000 for 25.68 per cent of the camel breeding families in the district. The income from camel herd per family seems to be low.

4.8.2 Camel pastoralism

4.8.2.1 Herd size and its structure

The size of the camel herd maintained by the traditional camel breeders in the district is presented in Table 4.8.5.

The camel herd size varied from less than 5 to as high as 100 camels in the district. Herd size of more than 50 camels was common (27.03%) in the district. Equal number of a camel herds (27.03%) were having lesser than 20 animals. About 46 per cent of the traditional camel breeders were having 21 to 50 camels in

Table 4.8.5 Camel herd size maintained by the traditional breeders

Herd size	No.of herds	Per cent
0 - 5	3	4.05
6 - 10	5	6.76
11 - 15	5	6.76
16 - 20	7	9.46
21 - 25	3	4.05
26 - 30	8	10.81
31 - 40	10	13.51
41 - 50	13	17.57
> 50	20	27.03
Total	74	100.00

their herds. NRCC, Bikaner also conducted survey on traditional camel management in the Kachchh district (Anonymous, 1992). In

the report, it was indicated that the herd size varied from small (5 - 15 camels) to large (80 - 150 camels). A few herd having more than 500 camels were also encountered. However, they have not indicated number of herds surveyed and talukas covered.

Herd structure maintained by the traditional Kachchhi camel breeders was also surveyed in Lakhapat, Bhuj and Rapar taluka of Kachchh district. The results are presented in Table 4.8.6.

Table 4.8.6 Kachchhi camel herd structure

Taluka	Male		Female		Total
	0-4 yrs.	Above 4 yrs.	0-4 yrs.	Above 4 yrs.	
Lakhapat (24)	6.38 ±1.14	0.63 ±0.10	12.67 ±1.71	22.42 ±2.43	42.08 ±3.88
Bhuj (25)	6.04 ±0.84	0.56 ±0.13	11.04 ±1.79	22.72 ±2.75	40.36 ±4.94
Rapar (25)	6.12 ±1.17	0.60 ±0.12	13.12 ±2.68	20.00 ±2.75	39.84 ±5.79
Pooled (74)	6.17 ±0.62	0.59 ±0.07	12.27 ±1.59	21.70 ±1.52	40.74 ±2.83

Figures in the parenthesis indicate number of observations.

Critical study of the data given in Table 4.8.6 indicated that the traditional camel breeders of Kachchh district had on an average 6.17 young males, 0.59 adult breedable males, 12.27 young females and 21.70 adult females making herd strength of 40.74 ± 2.83, without much variation in the three talukas. Thus each herd

was having about 55 per cent adult and 45 per cent followers. Lower than one adult breedable camel in the herd indicated that small herd did not have stud camel for breeding their females. They had to depend on herds of neighbours or relatives for breeding purpose. The herd structure of Kachchhi camels was more or less similar in the three talukas surveyed.

No published information is available on average herd structure of camel maintained by the traditional camel breeders. NRCC, Bikaner was having 55 per cent adult and 45 per cent young camels in its herds during 1991-1992 (Anonymous, 1992). This is in agreement with our findings.

4.8.2.2 Migration

The camels were taken for grazing away from the villages they belonged. All the 74 camel herds surveyed migrated from their village as a routine in search of feed and water. The herds men accompanied the camels. The extent of migration followed by Kachchhi camels is presented in Table 4.8.7.

Table 4.8.7 Extent of migration by Kachchhi camel herds

Taluka	Extent of migration					
	<u>Within talukas</u>		<u>Within district</u>		<u>Outside district</u>	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Lakhapat (24)	22	91.67		0.00	2	8.33
Bhuj (25)	24	96.00		0.00	1	4.00
Rapar (25)	21	84.00	4	16.00		0.00
Pooled (74)	67	90.54	4	5.41	3	4.05

Figures in the parenthesis indicate number of observations.

About 90 per cent of the camel herds used to migrate within the taluka to which they belong. About 5 per cent of the camel herds were migrating for grazing outside their taluka but within the Kachchh district. Very few (4%) camel herds of the district used to migrate in the other district of the state during lean months for grazing. These herds started migration after Diwali festival and reached upto Ahmedabad and Kheda district by about Holi in search of feed and water. These herds returned to their native place by onset of monsoon. The herds of Bhuj taluka used to migrate in the pasture land of Banni area and did not prefer to migrate outside the taluka.

The extent of migration by the Kachchhi camel breeders is thus limited. This might be due to sufficient browsing and/or grazing available in the district and also due to better pastoral skill of the camel breeders.

4.8.3 Housing facilities

While the survey information was collected on housing facilities for camels. The adult or young camels were not provided any type of housing. The forelegs of adults were tied and the adults were allowed to rest in open enclosures or open ground during night hours. The young animals were kept loose and they were resting with adults, without running away. Generally an open, flat and hard ground was preferred for resting. During monsoon season, slightly raised stony grounds were preferred. The animals were allowed to rest during mid-day in the grazing land some where near water spot without tying. A camel herd resting during day time is depicted in Plate XVIII.

The observation of present study were in close agreement with the reports of Prajapati (1993) who noticed that camel keepers of rural area in Mehsana and Sabarkantha district did not provide any special house/shelter to their camels. The camels were allowed to rest in open yard. Evans and Powys (1980) and Wilson (1986) also reported that the camels of Central and Southern Kenya were herded during the day and penned at night in open enclosures in the ranches.

4.8.4 Feeding and watering management

4.8.4.1 Feeding management

During the survey it was observed that the Kachchhi camels preferred to browse rather than graze (Plate XIX). The camels browse on varieties of trees and shrubs (Plate XX). They were enjoying the browsing and were making up their nutritional requirements solely by this way. The traditional camel breeders had good knowledge about trees and shrubs available. They had acquired skill from their ancestors for adopting suitable practice of browsing their camels. The traditional camel breeders carried their herd according to availability of feeds. Any kind of supplementary feeding was not practiced by the traditional camel breeders in Kachchh.

The Kachchhi camel breeders of the three taluka were having their own browsing practice. The duration of browsing provided to the camels by them is presented in Table 4.8.8.



Plate XVIII: A Kachchhi camel herd resting during mid day.

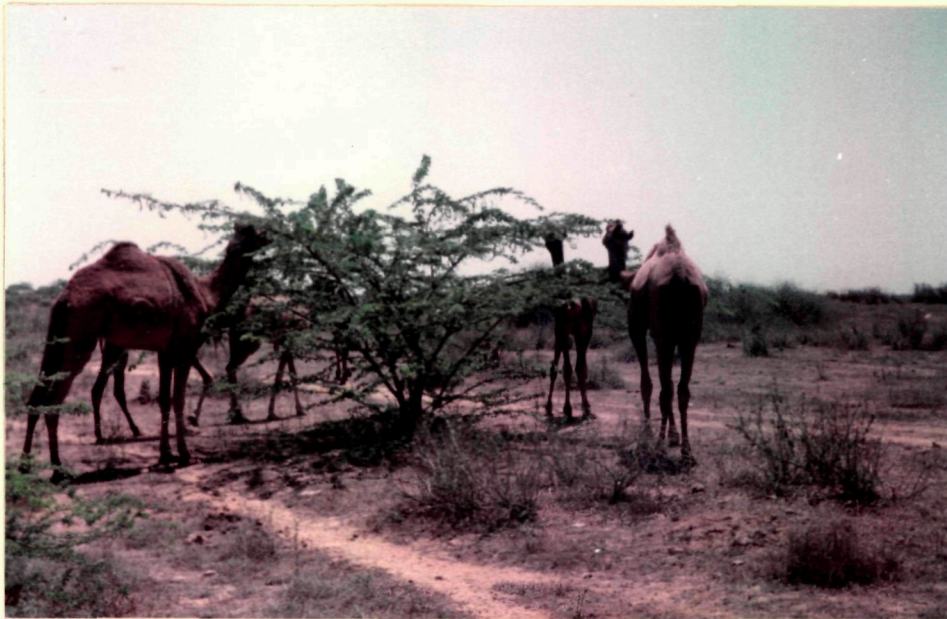


Plate XIX : Camel prefer to browse rather than to graze.



Plate XX : A Kachchhi camel herd enjoying browsing.

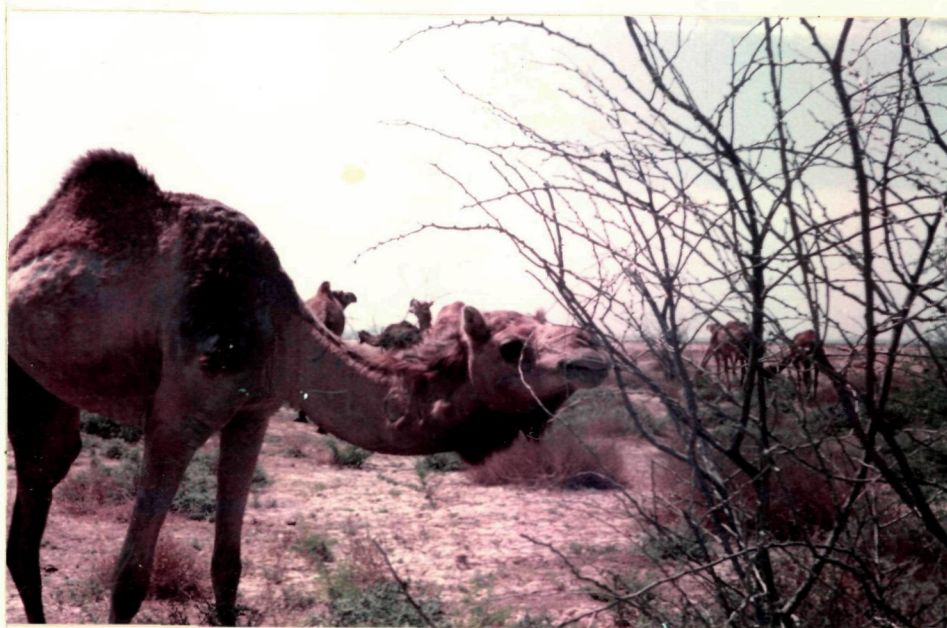


Plate XXI : Over browsing of trees should be avoided.

Table 4.8.8 Duration of browsing practiced by Kachchhi camel breeders (%)

Season	M o n s o o n				W i n t e r				S u m m e r			
	<----- Hours ----->				<----- Hours ----->				<----- Hours ----->			
Taluka	10	11-12	13-14	>14	10	11-12	13-14	>14	10	11-12	13-14	>14
Lakhapat (24)	12.5 (3)	70.83 (17)	12.5 (3)	4.17 (1)	33.33 (8)	66.67 (16)	0.00 (0)	0.00 (0)	0.00 (0)	100.00 (24)	0.00 (0)	0.00 (0)
Bhuj (25)	0.0 (2)	88.00 (22)	4.00 (1)	0.0 (0)	20.00 (5)	80.00 (20)	0.00 (0)	0.00 (0)	4.00 (1)	88.00 (22)	0.00 (2)	0.00 (0)
Rapar (25)	0.0 (2)	88.00 (20)	12.00 (3)	0.0 (0)	40.00 (10)	60.00 (15)	0.00 (0)	0.00 (0)	8.00 (2)	84.00 (21)	0.00 (2)	0.00 (0)
Pooled (74)	9.46 (7)	79.73 (59)	9.46 (7)	1.35 (1)	31.08 (23)	68.92 (51)	0.00 (0)	0.00 (0)	4.05 (3)	90.54 (67)	5.41 (4)	0.00 (0)

Figures in the parenthesis indicate number of herds men surveyed.

Majority (80%) of the traditional breeders in Kachchh allowed 11-12 hours of browsing per day to their camels during monsoon season. Very few of them (9%) were allowing browsing for either 10 hours or 13-14 hours daily, during the season. This was followed more or less in similar fashion in the three talukas during monsoon.

About 69 per cent of the traditional camel breeders were practicing 11-12 hours of browsing daily during winter in the district. Some of the camel breeders (31%) especially of Lakhapat and Rapar talukas practiced daily browsing for about 10 hours during winter season. Most of the traditional camel breeders (90%) allowed 11-12 hours of browsing daily to their camels during summer. The remaining traditional camel breeders allowed

their camels to browse for one more or less hour than the hours mentioned above, during summer especially in Bhuj and Rapar taluka.

As a general practice browsing duration of 11-12 hours was provided daily throughout the year by the traditional camel breeders. When plentiful vegetations were available, the duration was reduced hardly by one hour.

Matharu (1966) recommended minimum 8 hours of foraging by camels. While Anonymous (1992) observed daily browsing practice of 14-16 hours during summer and 10-12 hours during winter in the Kachchh district. Thus the browsing hours observed in the present investigation seem to be optimum.

4.8.4.2 Feed resources

The Kachchhi camels of the traditional camel breeders were solely dependent on natural feeds available on public grazing land. Therefore, it was of interest to list natural feed resources available for the camels in the district. A variety of trees, shrubs, and creepers plants were utilised by the camels. A list of such feeds was prepared with the help of personal inquiries with the traditional camel breeders as well as visits of grazing land.

Trees available in Kachchh

<i>Local name</i>	<i>Botanical name</i>
Baval	<i>Acacia nilotica</i> spp. indica
Bordi	<i>Zizyphus mauritiana</i>
Gorad	<i>Acacia senegal</i>

Gundi	<i>Cordia dichotama</i>
Khair	<i>Acacia catechu</i>
Khari Jar	<i>Salvadora persica</i>
Khejri	<i>Prosopis cineraria</i>
Kundher	<i>Premna obtusifolia</i>
Neem	<i>Azadirachta indica</i>
Mithi Jar	<i>Salvadora oleoides</i>
Peepla	<i>Ficus tsiela</i>
Sarugavo	<i>Moringa oleifera</i>
Tal Bavdi	<i>Acacia jacquemontii</i>
Vilayati baval	<i>Prosopis juliflora</i>

Shrubs available in Kachchh

Cheni bor	<i>Zizyphus nummularia</i>
Jawasi	<i>Fagonia cretica</i>
Luno	<i>Suaeda fruticosa</i>
Oin	<i>Cressa cretica</i>
Lokhiya	<i>Grewia</i> spp.

Creepers available in Kachchh

Dhudhal	<i>Leptadenia reticulata</i>
Fagval	<i>Rivea hypocrateriformis</i>
Gangeti	<i>Grewia tenax</i>
Pijolo	<i>Marua arenaria</i>
Saravo	<i>Asparagus racemosus</i>

The traditional camel breeders of Kachchh had acquired preference for certain feeds by camels through experiences and inheritate knowledge from parents. Very interestingly the

preferred feeds were palatable and nutritious according to present day knowledge.

Preferences during monsoon season

Dhudhal	<i>Leptadenia reticulata</i>
Fagval	<i>Rivea hypocrateriformis</i>
Gangeti	<i>Grewia tenax</i>
Pijolo	<i>Marua arenaria</i>
Saravo	<i>Asparagus racemosus</i>

Preferences during winter season

Mithi Jar	<i>Salvadora oleoides</i>
Gorad	<i>Acacia senegal</i>
Baval	<i>Acacia nilotica</i> spp. indica
Tal Bavdi	<i>Acacia jacquemontii</i>
Khejri	<i>Prosopis cineraria</i>

Preferences during summer season

Khari Jar	<i>Salvadora persica</i>
Luno	<i>Suaeda fruticosa</i>
Oin	<i>Cressa cretica</i>
Baval	<i>Acacia nilotica</i> spp. indica
Kundher	<i>Prema obtusifolia</i>
Jawasi	<i>Fagonia cretica</i>

Rathore (1986) reported that in the natural semi-wild state, where herds of breeding camels were kept, the camels were dependent entirely on browsing and grazing without any supplementary feeding. Such a practice was also observed in the

Plate XXII :

A tree species *Acacia senegal* is commonly preferred top feed



Acacia senegal

Plate XXIII:

Gundi (*Cordia gharaf*) as a top feed for camel.



Cordia gharaf

Plate XXIV :

Khejri is known as a
Kalpavruksh of deserts.



Prosopis cineraria

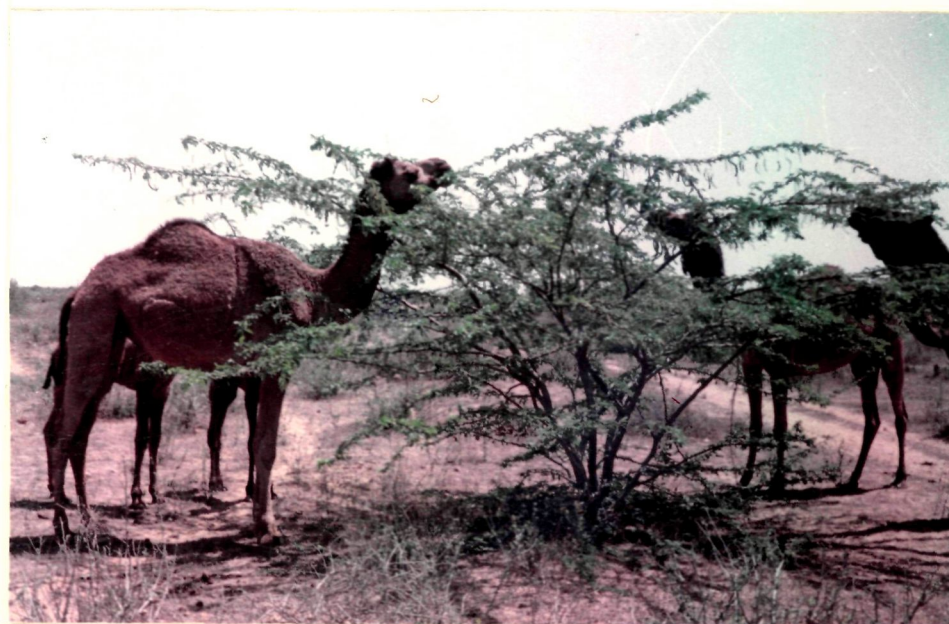


Plate XXV : *Prosopis juliflora* is widely spread
in Kachchh.



Plate XXVI : Luno is of preferences while grazing.

Plate XXVII :

Fagonia cretica from grazing
land of Rapar taluka.



Fagonia cretica



Cressa cretica

Plate XXVIII:

Cressa cretica a common plant available during summer in Banni grass land.

Plate XXIX :

Grewia species a common pasture plant available in Kachchh.



Grewia sps.

Plate XXX :

Leptadenia reticulata is a common creeper of Lakhapat taluka.



Plate XXXI :

Creeper of *Grewia* species





Plate XXXII :

Asparagus racemosus is a common creeper climbing trees in Kachchh.

present investigation. The lists of top feeds and plants available for feeding camels were also given by Chowdhary (1986^b), Rathore (1986), Anonymous (1992) and Prajapati (1993). Many of the feeds identified during the present investigation were found in the above reports.

4.8.4.2 Watering management

Camels are known to survive without water for a couple of days. They have preference for clean water. Considering the vital role of water in the body, it will be interesting to note frequency of watering followed for the Kachchhi camels.

The traditional Kachchhi camel breeders mostly (96%) watered their camels once a day during winter months, without much variation in the three taluka. During the summer months the Kachchhi camels were commonly (85%) watered twice daily. Few of the camel breeders, however, watered their camels either once a day (8%) or thrice a day (7%) during summer season. Watering the camels twice or thrice a day during summer months was a healthy practice followed by the traditional camel breeders. Contrarily to this, Anonymous (1992) reported that the traditional camel breeders of Rajasthan and Kachchh watered their animals twice a week. However, Prajapati (1993) observed watering of camels twice a day in rural area of the Mehsana and Sabarkantha district of Gujarat.

During the survey, it was observed that the Kachchhi camels were taken to ponds for watering during noon hours (Plate XXXIII). Generally it was convenient to allow the camels to rest nearby the watering spots during noon. Community water troughs

were also built in some villages (Plate XXXIV) for providing clean and fresh water to the camels. Irrespective of the source of water, the camels were allowed to drink water *ad libitum*.

4.8.5 Care and management of camels

4.8.5.1 Suckling camel calves

The traditional camel breeders watchfully attended calving in the camels. They helped the newborn calf in locating teats of its mother, so that it could get colostrum (Plate XXXV).

Majority (54%) of the traditional camel breeders allowed calves to suckle their mother more than five times daily. Nearly 40 per cent of the breeders allowed the calves to suckle colostrum 3 to 4 times a day. Very few (6%) traditional camel breeders allowed the calves to suckle colostrum at least twice daily. By this way the traditional Kachchhi camel breeders knew the importance of the colostrum for the calf and allowed it to suckle sufficient quantity of colostrum at frequent intervals. The camel breeders did not draw milk from the freshly calved she-camels for about 11 days post-partum.

As a common practice a calf was held at a secured place for about 3 to 5 days. It was not taken with the herd while grazing. The dam was brought to the calf for feeding the calf. Some herds men even did not take the calf with the herd for about 10 to 15 days. This might be to protect the calf from predators and from long distance travel and by this time the calf might have learnt walking and browsing or grazing. Once the calf was



Plate XXXIII: Ponds are common sources of drinking water for camels.



Plate XXXIV: Community water troughs are built by villagers for clean-fresh water.

with the herd, it could suckle the mother frequently. The suckling frequency and quantum of milk suckled were restricted after the calf attained the age of six months (Plate XXXVI). The restriction was imposed using a net, covering the udder of the mothers. Almost all the calves were allowed to suckle milk from their mother for full lactation or at least for one year.

Rathore (1986) also reported holding newborn calf at the camp till it could walk. Chowdhary (1986b) recorded *ad libitum* feeding of colostrum to camel calves. According to Anonymous (1992) traditional camel breeders in Bikaner district allowed camel calves to suckle milk from the dam freely. Malvi camel breeders allowed calves to suckle milk throughout the day except during night time (Kohler- Rollefson and Rathore, 1995). As per indication of Singh (1966) and Rao *et al.* (1970) traditionally camel calves were allowed to suckle their dams upto 12-15 months of age in India. The foregoing is in agreement with the observation recorded during the present study.

4.8.5.2 Growing calves

The growing young camels were kept with the herd of Kachchhi camels. They were depending solely on browsing for their nutritional requirements. Both, the male and female growing calves were kept with the herd without any special management. The male young camels were applied nose-pegs at the age of about 2-3 years. The nose-pegs were made either of wood, aluminium or brass. Nose-pegs were applied for better control of male camels. Singh (1966) also recommended application of nose-peg at any age after two years.



Plate XXXV : A newly born calf suckling colostrum from dam.

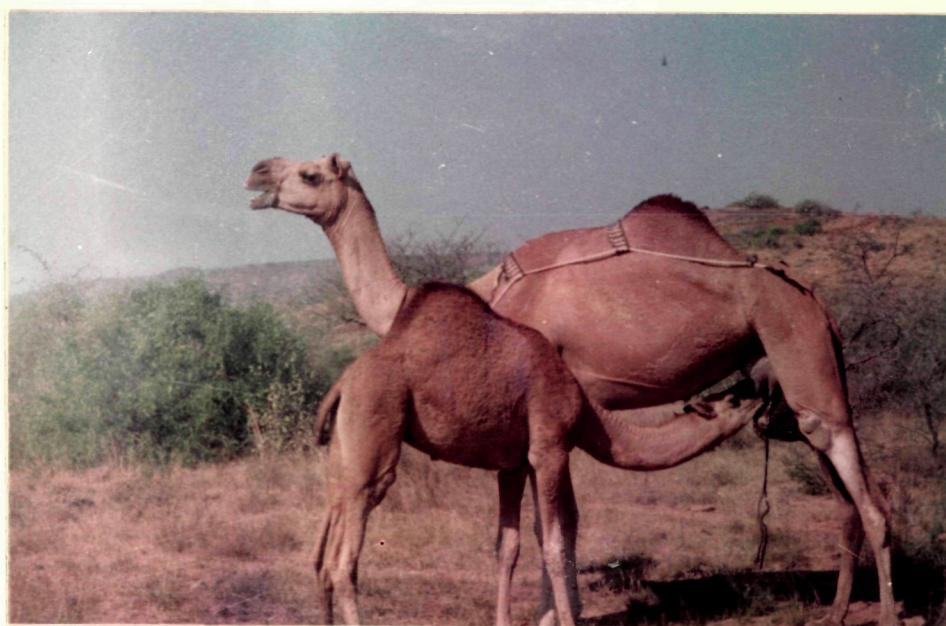
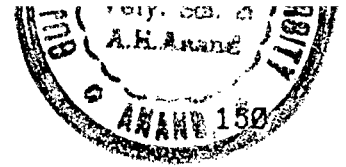


Plate XXXVI : A grown calf is allowed to suckle dam at limited times. Note the netting taken aside while suckling.



Male camels of about 2 1/2 to 3 years were marketed for draft purpose, if not required for breeding purpose. Sale of surplus male animals was the only source of income to the traditional camel breeders. There were no organised market or melas for marketing their animals. Generally, the male camels were marketed directly to its users or through some middle man. On an average male camel of 2 1/2 to 3 years fetched Rs.2,500 to 3,000. However, personal inquiry in Urban areas of Kheda district revealed that the camel cart owners had purchased male camels at the price of Rs.8,000 to 9,000. The exploitation of camel breeders needs to be checked.

Anonymous (1991) also noticed that the prime purpose of camel breeding by pastoralists in Rajasthan was for sale of draught animals but not for milk, meat or hair.

4.8.5.3 Breeding camels

All the female camels were retained in the herd for breeding purpose. Generally, female camels were not marketed at any age due to religious taboo. Even older and low productive females were maintained till death. As such they were not economically burden some and there were superstitious believes, the older and low productive female camels were not sold.

Emphasis was given to colour, outlook, development of udder, size and placement of teats, development of body and placement of legs in selecting females for breeding purpose. However, selection was not that critical.

The breeders followed natural service for breeding the animals. The breeders preferred to have their own male camel for breeding purpose. They used to exchange their stud camel with good stud camel from other herds. If this was not possible, they purchased breeding male camels from other herds. Small herds men rarely kept their own stud camel but it was obtained on loan service from relatives. Almost all traditional camel breeders were using one stud camel only for 3-4 years in their herd to avoid inbreeding.

The male camels to be used for breeding purpose in the herd, were selected on the basis of outlook and milk production of their mother, their own outlook and development of body and legs. They preferred a male camel with small head, erect ears, small chest pad and better height and length.

Breeding female and male camels were maintained on browsing round the year. The females were not given any supplementary feeding even during pregnancy and lactation. The stud camels were supplemented with energetic feed supplements like sweet oil, vegetable ghee or eggs. To increase their appetite, few traditional camel breeders used turmeric, 'Asalio' etc.

Traditional camel breeders of Rajasthan gave special attention to selection and management of stud camels (Anonymous, 1992). The male camels were selected on the basis of their pedigree, milk yield of their mother and sister as well as their body conformation, colour and facial expressions. The stud camels were exchanged after 4 years of use.

Kohler-Rollefson (1993) reported selection of breeding males on the basis of appearance, behaviour, physical strength and characteristics of their ancestors.

Anonymous (1992) also recorded feeding of ghee, oil, eggs, and boiled Guar etc. to the stud camels in the Kachchh district. In contrast to the findings of present study, Chowdhary (1986^b) and Prajapati (1983) indicated special feeding practices for pregnant and lactating camels.

4.8.6 Camel health

The collected information on health care provided to the traditional herds revealed that the camel breeders were not cautious and knowing about any preventive measures against infectious diseases and as such did not go for any kind of vaccination. Whenever there were outbreaks of diseases there were heavy mortalities. The common disease observed in very young animals were otorrhea, contagious ecthyma, pox, abscess and eczema. Growing animals generally suffered from surra, abdominal pain, bloat and eczema. In adult animals, the common disease encountered were surra, pneumonia, abscess, rheumatism and problems of ectoparasites viz., lice, mange and ticks etc.

Anonymous (1981) and Kohler-Rollefson (1994) gave Mange and Trypanosomiasis (Surra) as the major health problems in camels of pastoralists. Schwartz (1992) indicated that the major causes of calf mortality were malnutrition, pneumonia, internal parasites and tick infestation in camels of Kenya.

On personal discussion with the traditional camel breeders it was noticed that most of them (96%) relied upon 'Traditional wisdom' which was passed on to them by their forefathers. Very few (4%) of the traditional camel breeders consulted veterinarian or livestock inspector for health problem in their herds, that too when traditional methods of treatment did not meet with success. Many of the camel breeders relied on the advice given by so called experienced person (Vaid). Such a experienced person, traditionally treating camel, was consulted for details. He was reluctant to part with his knowledge of using local herbs and other materials for camel treatment.

Generally, the traditional camel breeders were using local herbs and materials for minor ailments in camels. Recently, some of the camel breeders have started using commercial pharmacological preparations without detail knowledge or consultations of veterinarians. However, they need to be questioned against side effects of such preparations and dangers involved.

Indigenous system of treatment in diseases of camel was commonly followed by traditional camel breeders in Rajasthan (Anonymous, 1991 and Kohler-Rollefson, 1994).

There is anurgent need to establish mobile veterinary clinics for advice and treatment of camel herds grazing in interior places. The camel breeders are to be advised for routine vaccination, deworming, spraying of insecticides etc. for protecting health of their valuable camels.

CHAPTER-V

SUMMARY AND CONCLUSIONS

The present survey/study was carried out to document breed characteristics, productive and reproductive performance of Kachchhi camels as well as traditional breeding, feeding, managerial and health care practices for the camels in their native tract. The information was collected through pre-set questionnaire covering 74 traditional Kachchhi camel breeders of three leading talukas in Kachchh district viz., Bhuj, Rapar and Lakhapat. Biometrical and physical characteristics of 326 Kachchhi camels were also recorded during the survey in the year 1995.

Salient findings of the study are as under :

5.1 DISTINCT BREED CHARACTERISTICS OF KACHCHHI CAMELS

The Kachchhi camels are handsome in look and light to medium in size. Their body coat colour varies from dark brown to brownish white with predominance of dark brown (42.69%), brown (27.49%) and reddish brown (21.35%). The camels have small erect ears with tips turning in. The camels have small and well set muzzles and lips. Adult she-camels have capacious bowl shaped udders with medium sized teats.

5.2 BODY MEASUREMENTS AT DIFFERENT AGES

Average body length in the Kachchhi camel was 61.17 ± 1.32 , 86.60 ± 2.62 , 97.58 ± 1.99 , 118.90 ± 1.73 and 159.82 ± 2.10 cm in males; and 61.46 ± 1.01 , 85.11 ± 2.19 , 97.75 ± 2.65 , 117.17

± 2.23 and 156.15 ± 0.76 cm in females at birth, 3 months, 6 months, 1 year and adult age, respectively. The sex differences for the body length were statistically non-significant at different age.

On an average height at withers of the camels was 110.42 ± 1.35 , 137.20 ± 1.38 , 137.92 ± 2.66 , 158.79 ± 2.43 and 195.00 ± 3.35 cm in male; and 109.15 ± 1.13 , 136.89 ± 1.84 , 142.75 ± 3.60 , 158.57 ± 2.04 and 192.16 ± 0.77 cm in female at respective age. The height at withers was at par for male and female camels of different age groups.

Average heart girth of the camels was 76.92 ± 2.81 , 109.80 ± 2.15 , 120.33 ± 2.39 , 150.62 ± 2.66 and 195.93 ± 2.11 cm in male; and 72.77 ± 1.56 , 114.00 ± 1.63 , 120.33 ± 3.21 , 148.27 ± 2.83 and 204.75 ± 10.77 cm in female of respective age groups. The heart girth was comparable in both the sexes of different age groups.

The study on other body measurements on Kachchhi camel indicated that all the measurements increased with growth of the animal without any significant effect of sex on them except at adulthood in few cases. In general, Kachchhi camels are moderate in length and height. They have thinner necks of moderate length. The tails are slightly shorter.

The height at wither in adult Kachchhi camel was having positive and significant ($P < 0.05$) association with most of the important body measurements indicating that height at wither of adult camel is a reliable measure for its growth.

5.3 REPRODUCTION

Most (62%) of the herds men surveyed mated their female camels first time at the age of 4 years whereas some (36%) of the herds men preferred to mate them as early as 3 years of age. The herds men put their male camels to first service at the age of 4 years (57%) or 5 years (43%). About 47 per cent traditional breeders used one stud camel for 50 to 70 females. Surprisingly, about 30 per cent of the traditional breeders were having one stud camel for mating more than 100 females. This suggested that traditional Kachchhi camel breeders should increase number of breeding males in their herd for better reproductive efficiency and genetic diversity.

Winter was the common breeding season for the Kachchhi camels. From the available data on 481 calvings of last 10 years, it was revealed that about 82 per cent calving occurred during December to March at Government Camel Breeding Farm, Dhori (Kachchh).

In majority (88%) of the Kachchhi camel herds, detection of oestrus (heat) in females was through the stud camels. However, all the traditional camel breeders were having confidence to detect pregnancy in female camels from typical cocking of tail on approach by a male. This behavioural sign could be useful to detect pregnancy as early as 10 to 15 days of conception.

Analysis of limited available data from Government Camel Breeding Farm, Dhori (Kachchh) indicated that the Kachchhi camels

were having average age at first calving of 1932.47 ± 48.52 days (64.4 months) and calving interval of 819.92 ± 36 days (27.3 months). However, annual calving rate of 36.21 per cent was observed in the camel herds of the traditional breeders in Kachchh. The Kachchhi camel breeders had good knowledge on external signs of approaching parturition. They commonly observed sign of getting isolated from the herd with udder and teat engorgement in parturient female camel.

5.4 MILK PRODUCTION

About 70 per cent traditional Kachchhi camel herds were giving daily 3 to 5 litres of milk per head. Actual daily milk yield recorded from 24 Kachchhi camels averaged 5.52 ± 0.29 litres. Analysis of camel milk revealed that on an average it contained 11.24 per cent total solids, 3.07 per cent fat, 4.27 per cent lactose, 2.85 per cent protein and 0.84 per cent ash. Specific gravity was found to be of 1.024.

During the survey it was observed that the camels were milked as and when required. However, as a common practice the camels were milked thrice a day. The milking was done in standing position after allowing the calf to suckle. The calf was allowed to suckle sufficient milk throughout the lactation. The milk obtained in the pail was utilized by the family members and was never sold.

5.5 MODEL CHROMOSOMAL PROFILE

The diploid chromosome number in Kachchhi camel was found to be 74, which included 31 pairs of acro-centric and 5 pairs of

sub-metacentric chromosomes. Both, X and Y chromosomes were also sub-metacentric.

5.6 TRADITIONAL CAMEL MANAGERIAL PRACTICES

Traditional camel breeders of Kachchh should be complimented for development and preservation of Kachchhi camel breed as their ancestral profession. About 78 per cent of them were from Rabari community. For about 51 per cent of the traditional breeders, Animal Husbandry was the only source of income. The breeders were not sure about their actual family income. This might be due to very high rate (96%) of illiteracy.

The herd size of Kachchhi camels varied from less than 5 to as high as 100 animals. About 27 per cent of the traditional camel breeders were having herd size of more than 50 camels. Average herd size was of 40.74 ± 2.83 camels with 6.17 young males, 12.27 young females, 0.59 breedable male and 21.70 adult females. All the camel herds migrated from their village in search of feed and water. About 90 per cent of them used to migrate within the taluka to which they belong. About 5 per cent of them were migrating outside their taluka but within the Kachchh district. Very few camel herds of the district were going outside the district, but remaining in the state, for grazing during lean months. The camels were not provided any house/shelter even during calving and were provided rest on open enclosures or ground.

The camels were maintained on extensive system of feeding management and no supplementary feeding was practiced. On an average daily 11 to 12 hours of browsing time was practice. The principal trees/shrubs/creeper available for browsing were Baval (*Acacia nilotica* spp. *indica*), Bordi (*Zizyphus mauritiana*), Gorad (*Acacia senegal*), Khair Jar (*Salvadora persica*), Khejri (*Prosopis cineraria*), Neem (*Azadirachta indica*), Mithi Jar (*Salvadora oleoides*), Tal Bavdi (*Acacia jacquemontii*), Luno (*Suaeda fruticosa*), Oin (*Cressa cretica*), Fagval (*Rivea hypocrateriformis*), Gangeti (*Grewia tenax*) and Pijolo (*Marua arenaria*).

The traditional Kachchhi camel breeders mostly watered their camels once in a day during winter season and twice in a day during summer season. Ponds were common source of water for them.

Majority of the traditional camel breeders allowed newborn calves to suckle colostrum more than five times daily. Generally the calf was taken with the herd after about 3 to 5 days. Weaning was not practiced as a rule. Calves were allowed suckling freely upto 8 months of age, thereafter suckling time was restricted using a net covering udder.

The growing male and female calves were kept solely on browsing without any special management. The male young camels were applied nose-pegs at the age of about 2 to 3 years. For the traditional Kachchhi camel breeders source of income from the herd was only sale of surplus males. The hair coat of camel was shorn once in a year and was used for preparing household articles.

The traditional camel breeders were using one stud camel only for 3 to 4 years in their herd. Stud camels were supplemented with energetic feed viz., oil, vegetable ghee or eggs during breeding season only.

The traditional camel breeders were not following any preventive measures against different diseases. They resorted to traditional indigenous medicines for treatment of their diseased camels. Consultation from veterinarian for treatment of animals was not that common.

CONCLUSIONS

1. The traditional Kachchhi camel breeders deserve compliments for development and preservation of the breed. The breed has not been evaluated and improved on scientific line. There is need to strengthen the only camel breeding farm (Dhori) in the state. Applied research on camel feeding, management, reproduction and health is needed.
2. Efforts should be made to supply superior stud camels to traditional camel breeders for breeding.
3. Mobile veterinary and extension services should be made available in the breeding tract of Kachchhi camels.
4. The milk production potential of the breed may be exploited by systematic breeding and the breeders may be educated to market camel milk for supplementary income.
5. The reproduction performance of the camels including those of Government farm should be improved through better care, management, feeding etc.

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Appendix-A

A questionnaire for traditional camel production practices followed in Kachchh.

Number: _____

1.0 Cast, Education and Socio-economic status:

1.1 Name of breeder :

1.2 Information collected at :

1.3 Native place of breeder :

1.4 Main occupation :

1.5 Annual income (approx.) :

1.6 Cast (Social category) : Maldhari/Nomadic/ST/SC/Baxi/Other

1.7 House for breeder family : Own/Rented/Not possessing

1.8 Farming category for the breeder Land holding

1.8.1 Big farmer

1.8.2 Small farmer

1.8.3 Marginal farmer

1.8.4 Landless agricultural labour

1.9 Education

1.10 Family size: Adult male Adult female Children

1.11 Livestock holding: Cattle/Sheep/Goat/Domestic camel

Total:

1.11.1 Information on camel herd

	0-4 yrs	Above 4 yrs	Total
Male			
Female			
Total			

1.12 Type of camel breeder: Stationary/Migratory

1.12.1 If migratory - There extent of migration and route

1.12.2 Family member(s) accompanying during migration with camel herd

1.13 How long involved in camel rearing?
Ancestral/Started himself

2.0 Informations on feeding, watering practices.

2.1 Information on grazing/browsing

Season	Fore-noon	After-noon	Total
Winter			
Summer			
Monsoon			

2.2 Preferences of camels in browsing/grazing

Season	Grazing plants	Loppings
Winter		
Summer		
Monsoon		

2.3 Supplementary feeds for camel calves.

2.4 Supplementary feeds for growing camels.

2.5 Special feeds for advance pregnant camels.

2.6 Special feeds for lactating camels.

2.7 Feeds of stud camel.

2.8 Feeding of adult she-camel (seasonwise)

	Leguminous (kg)	Non-leguminous (kg)	Total (kg)
Dry fodder			
Green fodder			

2.9 Information on concentrate, : At what time it is given
if given.

Self prepare/Readymade

2.10 Information on salt/mineral, if given :

2.11 Watering

2.11.1 Watering as per season:

Quantity of water and frequencies

Winter :

Summer :

2.11.2 Watering facilities : At home/In range/Community

3.0 Breeding practices

3.1 Breeding season

3.2 Age at first mating in months for females

3.3 Age at first service in males (months)

3.4 Signs of oestrus observed in females :

1.

2.

3.

4.

5.

3.5 Whether adopting natural mating: Yes/No

3.5.1 Owing stud camel for mating: Yes/No

3.6 How much early you can detect pregnancy in camels?

3.6.1 Signs of pregnancy visible

3.7 When does a she-camel return to heat, if not conceived?

3.8 Signs of approaching parturition:

- 1.
- 2.
- 3.
- 4.
- 5.

3.9 Criteria for selection of breeding camels

3.9.1 For male

- 1.
- 2.
- 3.
- 4.
- 5.

3.9.2 For female

- 1.
- 2.
- 3.
- 4.
- 5.

3.10 Upto which age animals are maintained for breeding:

Female camel :

Male camel :

3.11 Stud camel

3.11.1 Breeding male to females ratio in the herd.

3.11.2 Frequency of changing the stud camel in years.

3.11.3 Whether a stud camel is purchased or exchanged?

3.12 Sex ratio in the herd (last year)

3.12.1 No.of calves born:

Male:

Female:

3.12.2 No. of breedable females available:

4.0 Traditional care and managemental practices

4.1 Calf rearing

4.2 Colostrum feeding: Yes/No

Frequency per day:

4.3 Age at weaning: Months:-

4.4 Age of calf when it is taken with the herd for grazing

4.5 Housing: Open pen/Shelter/Shed

4.6 Disposal of surplus calves:	Age	Price	Purpose
	-----	-----	-----
	Male		
	-----	-----	-----
	Female		
	-----	-----	-----

4.7 Marketing of camels :

Place of market yard :

Period :

Season :

Price of adult male :

Price of adult female:

Price of youngone :

4.8 Care and housing of pregnant camel

4.9 Housing of growing and adult camels

4.10 Description of housing facility, if any

4.11 Indigenous practices like application of mud, oil etc.

4.12 Application of nose-peg

4.12.1 Age

4.12.2 Skill acquired or applied by expert

5.0 Milk and hair production

5.1 Milking practice

5.1.1 Method :

Frequency:

Time(s) :

5.1.2 Method for disposal: Co-operative/local trader/
of surplus milk not marketed

5.1.3 Price of milk sold : Rs. /ltr.

5.1.4 Daily milk yield per camel: _____

5.2 Hair production

5.2.1 Colour of hair

5.2.2 Yield(g)/Animal/Year

5.2.3 Utility of hair

5.2.4 Season of shearing

5.2.5 Hair marketing and price

5.3 Camel health

5.3.1 Common diseases observed

Camel calves	Growing camel	Adult camel
1	1	1
2	2	2
3	3	3
4	4	4

5.3.2 Details of treatment with name(s) of diseases

Indigenous method:

Consultation of veterinarian:

5.3.3 Prophylactic measures

5.3.4 Deworming practices

5.3.5 Annual expenditure on treatment of sick animals