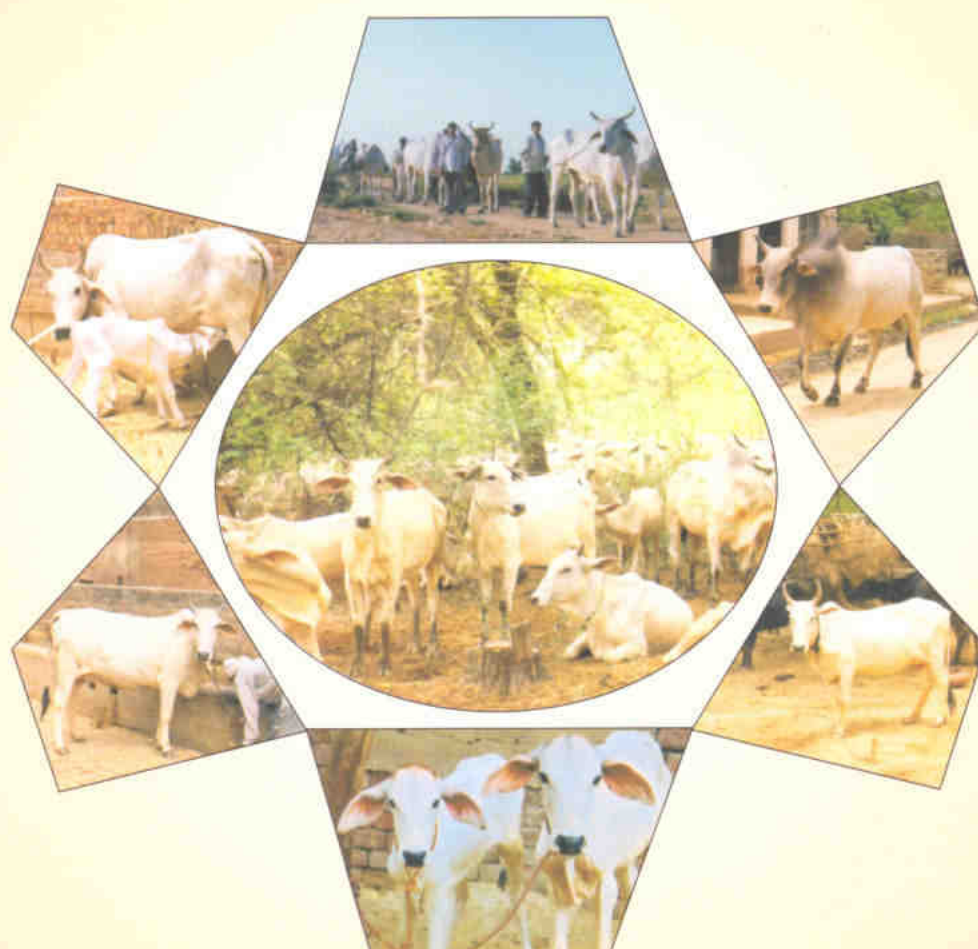


Cattle Genetic Resources of India

MEWATI

A Dual Purpose Breed



**P.K. Singh, R.K. Pundir, Karuna Asija, M. Mukesh,
Monika Sodhi, B. Prakash and S.P.S. Ahlawat**



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(Indian Council of Agricultural Research)
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MEWATI *Cattle*



Monograph 56, 2007

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MEWATI Cattle

Published by : Director
National Bureau of Animal Genetic Resources
P.O. Box - 129, Karnal - 132001 (Haryana) India

Cover Design : Karuna Asija

Printing : Intech Printers & Publishers
51-A, Model Town, Karnal - 132001
Tel. : 0184-4043541, 3292951



PREFACE

Mewati is a dual purpose cattle breed of north India. The breed is mainly distributed in two states i.e. Rajasthan and Uttar Pradesh. The cows of the breed possess average potential of milk production. The Mewati bullocks are in general sturdy, powerful and docile, and are useful for heavy ploughing, carting and drawing water from deep wells. The state of Rajasthan is rich in cattle biodiversity and more emphasis has been given to Rathi as milch, Tharparkar as dual and Nagori as draft purpose breed in the state. The Mewati breed is also facing very stiffer competition with crossbred cattle and buffalo in its breeding tract. Therefore, the breed is losing ground in Rajasthan and needs immediate attention for its conservation and genetic improvement. The Mewati animals are kept in thatched houses. The average herd size varies from 3 to 15. The physical traits of this breed are like Hariana but generally more loosely built with a high carriage of head and neck. The color of these animals is usually white but some parts of neck and shoulder and quarters are grayish/ darker shade. The average body length, height at withers and chest girth of cows are 115, 125 and 159 cm, respectively. Face length is 45.17cm in adult cows. Muzzle and eyelid are black in colour. The tail is long nearly reaching the heels. Mewati cattle have moderate basic temperament, medium sized dewlap, hump and well developed udder. The average daily milk yield of Mewati cows varies from 4 to 12 liters with an average of 6 liters. The molecular characterization of Mewati cattle by using 25 FAO recommended microsatellite markers revealed that the number of alleles varied from 5 to 13 across the microsatellite loci indicating high genetic diversity of these markers in the breed.

In the literature, the information on this breed is meager. The Scientists of NBAGR, Karnal have collected all the possible information for phenotypic characterization of the breed and molecular characterization of the breed was also completed by using 25 microsatellite markers. All these information were compiled in the shape of Monograph to document the breed. We are hopeful that this monograph will definitely help the academicians and policy planners in further development of the breed.

We express our gratefulness to Dr. Mangala Rai, Director General, ICAR and Dr. K.M. Bujarbaruah, DDG (AS), ICAR for encouraging and persuading us to undertake the documentation aspect of Animal Genetic Resources of the country. We wish to plunk our heartiest and candid thanks to Dr. B.K. Joshi, Director, NBAGR, Karnal for providing direction, support and suggestions in completing the assignment. We are also thankful to different divisions/ sections of Bureau like library, computer and photography sections.

Authors



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1. Introduction

The indigenous cattle of India are referred as Zebu which belongs to species *Bos indicus*. The Indian cattle differ from exotic cattle (*Bos taurus*) with respect to their prominent hump, orientation of horns and well developed dewlap. It is believed that domestication of Zebu cattle took place in Afganistan, Sindh, and Baluchistan before 4000 BC. Olver (1938) perhaps surveyed the cattle breed of India and proposed six different types of which large white cattle of North India was one. Mewati cattle belong to this category. Joshi and Phillips (1953) described the Mewati cattle in the group of short-horned white/light grey cattle with long coffin shaped skulls and slightly convex face. Acharya and Bhat (1984), described that Mewati as a dual purpose breed of cattle. As on today, it has been established that India is a mega diversity centre for cattle. The cattle diversity of India is reflected in terms of 33 listed breeds besides several lesser known populations which need to be recognized as a breed. These breeds have been evolved with interaction of genotype and environment along with some man made selection in 100s and 1000s years. These breeds evolved in different agro-climatic conditions, therefore, well adapted in those conditions. The indigenous breeds of cattle are unique in terms of disease resistance, heat tolerance and production with poor quality feed and fodder resources of India.

Cattle are the most important species in Indian agriculture and account about 38% of total livestock population in India. Cattle not only provide milk for human consumption but also contribute in terms of draft power (for agricultural operations and rural transport), soil fertility (through organic manure) and leather industry. Therefore, the cattle husbandry is an integral part of Indian agriculture.

The Indian cattle population has shown a decreasing trend since 1992 onwards. In 1951, the total cattle population of India was estimated as 155.30 million, which increased to 204.58 million (189.37 million indigenous and 15.22 million crossbreds) in 1992 and subsequently decreased to 185.18



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million (160.49 million indigenous and 24.69 million crossbreds) in 2003. On the contrary the buffalo showed an increasing trend and total buffalo population has increased to 97.92 million in 2003 from 43.40 million in 1951. The draft utility of cattle has been significantly reduced in certain parts of country especially Haryana, Punjab, Western U.P. and adjoining parts of Rajasthan. In these areas the farmers have replaced the indigenous cattle with crossbreds in need and greed of more milk at a greater extend as compared to other parts of the country. The population trends of cattle and buffalo also indicate that buffaloes are replacing cattle as the choice of animal for milk.

The change in utility and farming pattern has definitely affected the cattle biodiversity of the country. Many cattle breeds especially the draft ones are loosing grounds due to stiffer competition with buffalo and crossbred cattle. In such circumstances, it is imperative to describe and document the cattle breeds of the country in terms of their native tract, management and their performance under rural management. Therefore, an attempt has been made to document the Mewati cattle so that policy planners may formulate strategies for further development and conservation of indigenous cattle breeds.

2. Origin and geographical distribution of the breed

Mewati cattle originate in the tract known as Mewat, which includes some parts of South Delhi, Alwar and Bharatpur districts of Rajasthan, small part of Mathura district of UP and also some parts of Haryana. The breed is sometimes also called Kosi, due to fact that the large number of cattle of this breed were sold from the market at Kosi, a small town in the district Mathura. The animals are mainly distributed in Chhata tehsil of Mathura district (U.P.) and Alwar and Bharatpur districts of Rajasthan. Mewati cattle resemble phenotypically to the Haryana breed of cattle but show definite evidence of Gir blood. It is believed that native habitants of Rath and Nagori cattle being adjacent to Mewat, these two breeds may also have contributed to the formation of the Mewati. The main breeding tract of Mewati cattle has been shown in Fig.-1.



Fig.1- Geographical distribution of Mewati cattle

3. Location and topography of the breeding tract

Mathura town is situated at the bank of river Yamuna, down stream of Delhi at latitude $27^{\circ} 30' N$ and longitude $77^{\circ} 42' E$. The altitude of Mathura is 127 m above msl. It is located at a distance of 145 km south-east of Delhi and 58 km north-west of Agra. Alwar district is situated in the north-east of Rajasthan between $27^{\circ} 4'$ and $28^{\circ} 4'$ north latitudes and $76^{\circ} 7'$ and $77^{\circ} 13'$ east longitudes. The distance of Alwar from Delhi is 160 kms. Alwar is bounded on the north and north-east by Gurgaon district of Haryana State and Bharatpur district and on the north-west by Mahendragarh of Punjab State, on the south-west by Jaipur district and on the south by Sawai Madhopur and Jaipur district. The total area of the district is 8380 sq kms. The district headquarters is located at Alwar. Bharatpur is situated $26^{\circ} 22'$ to $27^{\circ} 83'$ North latitude and $76^{\circ} 53'$ to $78^{\circ} 17'$ East longitude. It is situated 100 meters above the msl. The district has an area of 5,066 km². It is 184 km away from Delhi in South-East. Northern Border of the district touches district Gurgaon of state Haryana, eastern Border touches district Mathura, southern border touches



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district Agra of state Uttar Pradesh and district Dholpur in the south of Rajasthan. It touches district Dausa in south-west and district Alwar in the North-West. The town of Bharatpur is the district headquarters.

Alwar district is characterized by topography of more or less flat-topped hills, which become more prominent and precipitous in the south-western parts of the district forming the northern continuation of the main Aravalli ranges. They enclose between them fertile valleys and high tableland. The drainage belonging to the Sota, Sahibi and Barah network is in land and ephemeral. The central part of the district is covered by Aravalli hills, which run north-south ranging in height from 456 meters to 700 meters.

4. Native environment and climate of the breeding tract

4.1 Climate

The climate of Mathura district is dry whereas Alwar enjoys a semi-arid climate with hot summer and cold winter with a short monsoon break. The heat is intense in May and June. Western hot winds blow with great intensity in these months. The temperature raises up to 47° Celsius during the summer and it goes down to 4.2° Celsius in winter in the breeding tract of Mewati cattle.

Table-1: Average temperature in breeding tract of Mewati cattle

	Particulars	Mathura	Alwar	Bharatpur
In summer	Maximum temperature	47°C	41°C	45°C
	Minimum temperature	31.9°C	24°C	37°C
In Winter	Maximum temperature	31.7°C	31°C	31.7°C
	Minimum temperature	4.2°C	11°C	7.0°C

Average relative humidity ranges from 32 to 82 % in the breeding tract.

Soil type: In Mathura and Alwar the soils are alluvial in nature and affected by salts. Bharatpur district also has rich alluvial soils, the fertility



of which is replenished every year by the flood water of the rivers. In periods of heavy rainfall, the rivers outflow their banks and inundate the surrounding villages.

Rainfall: In Bharatpur, the rainfall is low to moderate around 31.87 cm but it is relatively higher in the east, the rainfall during 1995 and 1996 was 15 to 18% above the normal whereas during 1997 to 2000 it was 5 to 28% below normal. The normal annual rainfall in the Alwar district is 57.77 cm and of Mathura district is 65 cm. The best season of rainfall is July to September in all the three districts.

4.2. Vegetation

Alwar is agriculturally fertile with about 72% of the total area in the district being covered under cultivation. This factor has been instrumental in promoting agro-based industries in Alwar. The main export from the Alwar district is mainly agricultural produce like food grains, oil seeds, edible oils, and spices. In Bharatpur natural vegetation exists on mountain slopes, wetland areas, and protected zones but the excessive plundering of forest wealth has dwindled the natural cover. Mathura district of Uttar Pradesh is also agriculturally fertile.

4.3 Crops grown in area

Kharif crops grown in the area include *bajra*, *jowar*, *maize*, *tur* and other pulses. Rabi crops include wheat, barley, and gram. Some other cereals and millets are also grown. Potato, ash gourd, vegetable pea, garlic, onion, spices and flowers are also cultivated in Mathura. In Bharatpur district, *bajra*, *jowar*, *til*, *dhaincha* are the major kharif crops and mustard, wheat and gram are the main rabi crops. Wheat production dominate followed by *bajra* and mustard. Twenty-eight percent of the area under mustard was rain-fed compared to 2% of the wheat cropped area, indicating that mustard would continue to be a more regular source of biomass, less susceptible to fluctuations in irrigation.



4.4 Fodder crops

Doob, motha and Kena grasses. Oat, Berseem, MP Chari, Maize, *Jowar* and *Bajra* are major fodder crops grown in the area.

4.5 Irrigation

Main sources available for irrigation in the Mathura and Alwar districts are wells and tanks. Bharatpur region produces a variety of crops because both surface water and ground water irrigation sources exist. A network of canals drawn from the upper Yamuna canal and the Panchana dam irrigate this area. The ground water aquifers vary from 5 to 15 meters and therefore, well water irrigation is also practiced. Irrigation in the area is mostly done by dug wells, energized tube-wells and canals emanating from irrigation tank, like Jaisamand, Siliserh, Mangulasar, Baleti and Deooti.

4.6 Drinking water

During the survey of the breeding tract of Mewati, the livestock owners informed that there is severe problem of drinking water for human as well as livestock. The underground water in the area is hard and salty. The State government has made some efforts in the rural areas by providing India mark hand pump in the villages but the number of hand pumps are too less as compared to requirement of human and livestock population in the villages. Inadequate drinking water has adverse effect on health of the human and livestock.

5. Selection of villages for the survey

A pilot survey was conducted for characterization of Mewati cattle in eight villages of five blocks in three districts, one from U.P. and two from Rajasthan.

Table- 2: Selected villages of the breeding tract

State	District	Block/ Tehsil	Villages
Uttar Pradesh	Mathura	Barsana	Kosi, Lalpur, Kamar
Rajasthan	Alwar	Tijara	Hasanpur, Madha majara
		Ramgarh	Alwada
	Bharatpur	Kumher	Sikrori
		Deeg	Badangarh



6. Socio-economic status of Mewati owners

6.1 Community responsible for rearing of breed

The communities mainly responsible for developing the breed include *Mews* and *Yadav*. However, all the communities available in the area are rearing the breed. The rich farmers preferred to have crossbred animals for higher milk. Women are playing an important role in different aspects of cattle husbandry. There was an animal market at Kosi twice in a week for sale and purchase of animals.

6.2 Human population

Total human population of the Alwar district according to 2001 census was 2.99 million comprising of 1.59 million males and 1.40 million females and of Bharatpur was 2.10 million comprising of 1.13 million males and 0.97 million females. Population living in rural area was 2.0 million (86.9%) while 0.3 million people were living in urban area. The Scheduled castes and scheduled tribes population was 0.4 million (17.4%) and 0.2 million (8.7%), respectively. The population density of Bharatpur (414) and Alwar (357) is considerably higher as compared to that of entire Rajasthan (165). The decennial growth rate of the population in urban area was 2.5 times than that of rural area. Hindi, Punjabi, and Rajasthani are the main languages spoken in the district. Hinduism is the main religion (2.0 million) followed by Islam (0.2 million). In Mathura the total population in 1991 was 1.65 million out of which 80.6% are rural population, 19.4% urban population. The Schedule caste and Schedule tribe are 21.6% and 2.3%, respectively. The sex ratio (Females per 1000 males) in Mathura district is 857 as compared to 887 of Alwar district. The growth rate in human population in Alwar and Bharatpur district during 1991-2001 was observed as 30.23 and 27.05%, respectively.

6.3 Literacy rate

Overall literacy rate in Alwar and Bharatpur district was 62.48 and 64.24%, respectively in 2001. In males the corresponding literacy rate was



78.91 and 81.31% whereas in females 43.95 and 44.12%. Literacy rate in Mathura district was 35.3% with male and female literacy rate as 49.4% and 18.04%, respectively.

7. Management practices in rearing of Mewati cattle

7.1 General animal husbandry in the breeding tract of Mewati cattle

In the breeding tract of Mewati, majority of the farmers rear cattle, buffalo and goat along with the crop farming. Some farmers also rear sheep and pigs and sometimes desi poultry in backyard system. The farmers rear cattle, buffalo, sheep and goats separately or in a combination of more than one species. The choice of animal for milk production in the area is buffalo followed by crossbreds and indigenous cattle. Due to fast farm mechanization in the area, the population of indigenous cattle is showing a declining trend whereas buffaloes are showing an increasing trend. Among the buffalo breeds of the

Table-3: Population of different livestock species (in Lakh) in the breeding tract of Mewati cattle(1997)

SNo.	District	Cattle	Buffalo	Sheep	Goat	Pigs	Others	Total livestock	Total Poultry
1	Alwar	2.05	7.65	1.10	4.95	0.20	0.27	16.20	2.43
2	Bharatpur	1.04	5.35	0.90	1.50	0.27	0.09	9.10	0.81
3	Mathura	1.09	4.16	0.37	0.72	0.35	0.12	6.87	0.34
	Total	4.18	17.16	2.37	7.17	0.82	0.48	32.17	3.58

area, mostly Murrah and various grades of Murrah were seen. Among the goats, most prominent breed is Barbari. The population of different livestock species and poultry are depicted in the table 3.

7.2 Housing and sanitation

The animals are kept in open or *Kachcha* houses nearby the farmers' houses. The roofs of the animal houses are generally made up of *Chapper* (thatched) but some farmers provide concrete houses to their animals.



Fig. 2 - Closed housing with muddy walls



Fig. 3 - Closed housing with brick walls



Fig. 4 - Open housing



Fig. 5 - Thatched housing without wall

The floors of the animal houses are generally *Kachcha type*, the bedding of cereal husk was provided to the animals. The drainage of animal houses is average or poor. The shade of trees is available for animals kept in open space. Generally the animal houses are well ventilated.

7.3 Breeding

The breeding of animals is generally through natural service due to unavailability of Mewati bull semen at the AI centers of the area. In villages breeding bulls are available. One bull generally covers the cows of three to four adjacent villages. No selection is practiced for developing the bulls rather the bull calves of good physical health are left for breeding at random. These bulls are not maintained by any farmer but used for the service of the cows of entire village(s). At some *Gaushalas* in the area, one or two bull (the



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progeny of high milk yielder cows) are kept and used for breeding of cows at *Gaushala* as well as nearby villages. The draft utility of the breed has been declined, therefore, the farmers preferred to bred their cows with exotic bull semen, however, some farmers are still of the opinion to maintain indigenous cows due to its milk quality. In the area the people's preference



Fig.6 (a&b)- Mewati Bull

for the milk was buffalo followed by indigenous cows. The A.I. programme in the area included the semen of Holstein Friesian/ Jersey breed only for cattle and Murrah for buffaloes. The farmers were well aware of signs of oestrus and significance of A.I.

7.4 Feeding

The pasture area is limited in the breeding tract of Mewati cattle; therefore, the animals are kept either totally on stall-feeding or on grazing for a period of 2-4 hours in a day along with stall-feeding. The balanced feeding was rarely observed but concentrates mixture, incorporating wheat or other cereal, wheat bran and mustard cake, in limited quantity i.e. 2-3 kg is given to cows at the time of milking along with straw. The feeding mainly depends on the byproducts of cereal farming. The availability of green fodder in the area is fair but first priority of green fodder feeding is buffalo rather than cattle. Major grasses in the area include *Pennisetum eeuchroides*, *Andropogon pertusus* and *Cnodon dactylous*.



7.5 Diseases and problems of farmers

The prevalent diseases in the area include FMD, H.S., BQ, Surra, Fascioliasis, Amphistomiasis etc. The State Department of Animal Husbandry is taking care of prophylaxis and treatment of these diseases. Reproductive problems are less, abortion and retention of placenta is observed hardly in 0.5% cases and dystokia in about 2% cases.

The major problems of the farmers include unavailability of adequate grazing land. The semen of Mewati bull is needed at the Hospitals so as to maintain the breed purity. The drinking water for human and livestock consumption is also inadequate in that area.

7.6 Herd size

The herd size varied from 2 to 15 animals. In villages farmers generally keep 2-3 cows for milk and rarely a pair of bullock for different agricultural operations, in Alwar the bullocks are very less in number.



Fig.7(a & b)- Herds of Mewati cattle during grazing

8. Population trend of cattle and buffalo in the area

The breed-wise population is not available, however, the species-wise population trends in the area during 1988-2003 indicated that the cattle population is decreasing and buffalo population is increasing. It is due to farm mechanization and reduced utility of the bullocks for agricultural operations. The choice of animal for milk is buffalo in the area; some farmers



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also reported migration of cattle from Rajasthan due to draught in the past few years. The population statistics in three districts is shown in the table 4.

Table-4: Population Trend of cattle and buffalo (in Lakhs)

District	Year	Cattle				Buffalo			
		M>3Y	F>3Y	Calves	Total	M>3Y	F>3Y	Calves	Total
Mathura	1988	0.63	0.61	0.56	1.80	0.26	2.22	1.69	4.17
	1993	0.23	0.44	0.38	1.15	0.19	2.11	1.48	3.78
	1997	0.09	0.59	0.41	1.09	0.18	2.24	1.74	4.16
	2003	-	-	-	1.31	-	-	-	6.66
Alwar	1992	0.75	1.52	0.31	2.58	0.47	5.33	1.35	7.15
	1997	0.23	0.98	0.84	2.05	0.03	3.99	3.63	7.65
	2003	-	-	-	1.83	-	-	-	9.17
Bharatpur	1992	0.21	0.57	0.43	1.21	0.06	2.56	1.96	4.58
	1997	0.08	0.54	0.42	1.04	0.04	3.08	2.23	5.35
	2003	-	-	-	1.07	-	-	-	6.96

Source: Information Collected from District Headquarters of Animal Husbandry Department

9. Utility of the breed

Mewati cattle are in general, sturdy, powerful and docile, and are useful for heavy ploughing, carting and drawing water from deep wells. The cows are good milkers. Therefore, the Breed is a dual-purpose cattle breed. Due to fast farm mechanization in the area, the utility of bullocks is reducing very fast. The agricultural operations in villages are rarely being done with the help of bullock power. Therefore, the breed is losing ground in competition of buffalo and crossbreds as milch animal.



Fig.8 - Mewati bullock pair



10. Phenotypic characteristics of the breed

10.1 Physical characters

The physical traits of the Mewati cows may be described as follows:

Coat colour: The animals are usually white in colour but some parts of neck and shoulder and quarters are grayish/ darker shade. The darker shades are more prominent in bulls as compared to cows.

Head and Neck: The head and neck show an upright carriage. Fore head is straight, sometimes slightly bulging. The face is long and narrow. The neck and the whole frame are strong but the limbs are light.

Muzzle: The muzzle is wide and square. The upper lip is thick and overhanging giving the upper part of the nose a contracted appearance. The muzzle pitch is black in color.

Horns: Horns emerge from the outer angles of the poll, black in colour but in some cases brownish/muddy appearance is also noticed. Orientation of horns is outwards, upwards, inwards and pointed tips in about 60 % cases, whereas in others it is outwards and upward with pointed tips and comparatively smaller in size.

Eye: Eyes are prominent and surrounded by a very dark rim and eye lids are black.

Ears: The ears are in horizontal orientation with moderate size.

Hump and dewlap: The dewlap is medium, though hanging but not very loose. Naval flap is small and basic temperament is moderate.





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Hoof: The hooves of animal are black in colour but in some cases muddy appearance is also noticed. The inter digital space is narrower than the crossbred animals.

Body: The legs are relatively long and the frame of the body gives an impression of being loosely built. The chest is deep but the ribs are flat. The sheath is loose but not pendulous. The legs are strong, somewhat large hooves, well-rounded in shape.

Udder and teats: Bowl shaped fore and rear udders, shape of teats is cylindrical, teat tips are rounded and milk vein is moderate. Cows usually have well-developed udders.



Fig.9- Udder and Teats (Fore view)



Fig.10- Udder and Teats (Rear view)

Tail: Black in colour, long nearly reaching the heels. The tail bears black hair.

Bhasin (1969) discussed the physical traits of cattle stated that like Haryana, Mewati are somewhat high on the leg but are generally more loosely built with a higher carriage of head & neck. The special points are:

- The comparatively long narrow face with somewhat bulging forehead and horns which emerge from outer angles of the poll and are inclined to turn backwards at points.
- The comparatively long frame with drooping quarters and light limbs.
- The pendulous but not over developed sheath.
- The large hump placed in front of withers.



- The well developed dewlap and tail of moderate length with black switch reaching about half way between hock and the ground.

10.2 Morpho-metric traits

A total of 379 animals were measured for body length, height at withers, chestgirth, paunch girth, face length, ear length, horn length and tail length. District-wise and age-group wise number of animals considered for body measurements is given in the following table 5.

The data of body measurements was analysed district-wise and pooled and the mean along with S.E. and coefficient of variation (in parentheses) has been depicted in the Tables 6-9.

Table-5: Number of Mewati animals considered for body measurements

District	Group					Total
	Cows	Males (1-3y)	Females (1-3y)	Calves	Bullocks	
Mathura	63	14	21	23	08	129
Alwar	51	07	19	39	04	120
Bharatpur	66	10	27	26	01	130
Total Animals	180	31	67	88	13	379

10.2.1 Body length

The overall body length of calves below 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 67.42, 86.97, 89.67, 114.80 and 117.69 cm, respectively. The mean value of body length ranged from 108.95 to 119.35, 113.75 to 124.0 cm in adult cows and bullocks, respectively across the three districts in the study. The average body length of adult Haryana male and Haryana cow has been reported as 126.31 cm (Kumar, 1977) and 139.2 cm (Joshi *et al*, 1995) which is much higher than the values obtained for the Mewati cattle.



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Table-6: Means of the morpho-metric-measurements (in cm) of Mewati cattle- in Mathura district

TRAITS	Adult Cows N=63	Bullocks N=8	Calves (<1y) N=23	Males (1-3y) N=14	Females(1-3 y) N=21
Body Length	108.95±0.91 (6.62)	113.75±2.71(11.71)	62.13±2.29(17.69)	80.43±2.82(13.14)	78.10±3.66(21.50)
Height at Withers	127.78±0.92(5.73)	138.75±5.05(10.29)	85.35±2.23(12.53)	104.21±2.79(10.00)	101.14±2.86(12.95)
Chest Girth	162.54±1.32(6.47)	167±4.57(7.73)	91.96±3.31(17.24)	120.71±4.00(12.38)	120.95±4.60(17.41)
Face Length	42.60±0.39(7.32)	47.5±1.30(7.71)	26±0.82(15.08)	34.21±0.83(9.04)	33.86±0.92(12.40)
Ear Length	25.62±0.36(3.24)	24.63±0.57(6.49)	18.39±0.65(16.94)	21.21±0.43(7.66)	21.71±0.74(15.63)
Tail Length	69.02±0.91(10.45)	69.75±1.10(4.45)	38.09±1.15(14.47)	53.07±3.34(23.54)	49.90±2.24(20.57)

10.2.2 Height at withers

Overall height at withers in the age groups of calves below 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 83.81, 103.68, 105.24, 125.44 and 138.92 cm, respectively. In Mathura, Alwar and Bharatpur districts the mean height at withers of adult cows were recorded as 127.78, 125.25 and 123.35 cm, respectively whereas the mean value for the trait for bullock in Mathura and Bharatpur were obtained as 138.75, and 139.20 cm, respectively. The mean height at withers in Haryana

Table-7: Means of the morpho-metric-measurements (in cm) of Mewati cattle- in Alwar district

TRAITS	Adult Cows N=51	Calves (<1y) N=39	Males (1-3y) N=7	Females (1-3 y) N=19
Body Length	119.35±0.88 (5.27)	68.95±1.58 (17.69)	91.71±3.22 (9.31)	94.63±2.53 (11.66)
Height at Withers	125.25±0.68 (3.88)	83.33±1.37 (10.24)	102.71±1.55 (4.00)	107.21±1.66 (6.77)
Chest Girth	158.96±1.34 (6.06)	84.03±2.11 (15.74)	114±4.19 (9.73)	123.47±2.77 (9.78)
Paunch Girth	170.76±1.68 (7.01)	85.18±2.92	120.71±3.12 (6.84)	131.26±3.43 (11.39)
Face Length	46.73±0.31 (4.77)	26.51±0.62 (14.60)	35.57±0.57 (4.25)	39.47±0.76 (8.46)
Ear Length	25.43±0.32 (9.08)	18.26±0.35 (11.84)	21.29±0.87 (10.75)	23.26±0.45 (8.58)
Horn Length	18.33±0.98 (34.37); N=41-		-	-
Tail Length	82.47±0.64 (5.58)	44.92±1.06 (14.69)	59.86±1.88 (8.32)	66±1.49 (9.86)



Table- 8: Means of the morpho-metric-measurements (in cm) of Mewati cattle- in Bharatpur district.

TRAITS	Adult Cows N=66	Bullocks N=5	Calves (<1y) N=26	Males (1-3y) N=10	Females (1-3 y) N=27
Body Length	116.86±0.82 (5.73)	124.0±3.86 (6.96)	69.81±2.02 (14.73)	92.80±2.01 (6.85)	95.19±1.64 (8.99)
Height at Withers	123.35±0.72 (4.75)	139.20±1.83 (2.93)	83.15±1.83 (11.24)	103.60±1.98 (6.04)	107.04±1.72 (8.33)
Chest Girth	155.60±1.38 (6.16)	175.80±4.84 (15.44)	85.54±2.59 (10.62)	115.40±3.88 (7.18)	127.44±2.99 (12.20)
Paunch Girth	165.72±2.26 (11.10)	181±5.51 (6.81)	87.58±3.14 (18.30)	121.80±4.73 (12.29)	128.56±3.27 (13.23)
Face Length	46.41±0.30 (5.17)	51.20±1.15 (5.06)	27.08±0.81 (15.21)	38.0±1.14 (9.45)	40.0±0.76 (9.83)
Ear Length	24.95±0.26 (8.56)	27.60±1.28 (10.44)	17.73±0.49 (14.05)	22.30±0.83 (11.77)	23.07±0.46 (10.26)
Horn Length	15.50±0.80 (34.30)N=56	40.75±4.27 (20.95)N=4	-	-	-
Tail Length	83.13±0.83 (7.94)	89.0±1.95 (4.90)	46.46±1.28 (14.03)	61.90±2.53 (12.93)	70.96±1.93 (14.10)

males and females were obtained as 136.25 (Kumar, 1977) and 136.13 (Joshi *et al* 1995). It indicated that the height at withers of Mewati and Hariana males are comparable but the Hariana females possess more height as compared to Mewati females.

10.2.3 Chest girth

The average chest girth in age groups of calves up to 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 86.54, 117.48, 124.28, 159.0 and 170.38 cm, respectively. The chest girth of the cows varied from 155.60 to 162.50 cm in three districts of the breeding tract of Mewati cattle. The mean chest girth of Mewati bullocks was more in Bharatpur as compared to Mathura district. Joshi *et al* (1995) obtained overall mean of chest girth of female as 169.82 cm in Haraina cows which is higher than Mewati cows. The average chest girth of adult male has been reported



Table- 9 : Means of the morpho-metric-measurements (in cm) of Mewati cattle-Pooled in three districts

Traits	Adult Cows N=180	Bullocks N=13	Calves (<1y) N=88	Males (1-3y) N=31	Females (1-3 y) N=67
Body Length	114.80±0.60	117.69±3.46 (7.01)	67.42±1.14 (10.59)	86.97±1.90 (15.81)	89.67±1.77 (12.15) (16.15)
Height at Withers	125.44±0.48 (5.11)	138.92±3.10 (8.03)	83.81±0.99 (11.11)	103.68±1.42 (7.63)	105.24±1.25 (9.76)
Chest Girth	159.0±0.81 (6.84)	170.38±3.47 (7.34)	86.54±1.51 (16.38)	117.48±2.38 (11.28)	124.28±2.03 (13.40)
Paunch Girth	167.93±1.48 (9.55) N=117	181±5.51 (6.81) N=5	86.14±2.15 (20.09) N=65	121.35±2.99 (10.16) N=17	129.67±2.37 (12.39) N=46
Face Length	45.17±0.24 (7.15)	48.92±1.02 (7.53)	26.55±0.42 (14.82)	35.74±0.60 (9.39)	37.93±0.57 (12.42)
Ear Length	25.32±0.18 (9.68)	25.77±0.71 (9.91)	18.14±0.27 (11.89)	21.58±0.38 (9.85)	22.70±0.33 (11.85)
Horn Length	17.84±0.62 (34.23) N=97	40.75±4.27 (20.95) N=4	-	-	-
Tail Length	77.19±0.69 (11.75) N=177	77.15±2.87 (13.41)	43.59±0.76 (16.25)	57.45±1.87 (18.14)	62.96±1.57 (20.47)

Figures in parentheses indicate coefficient of variation in %, N is number of animals.

as 156.79 cm. (Kumar, 1977) in Haryana cattle which is lesser than the chest girth of Mewati bullocks.

10.2.4 Paunch girth

The paunch girth in age groups of calves up to 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 86.14, 121.35, 129.67, 167.93 and 181.0 cm, respectively. The paunch girth of Haryana cows was obtained as 193.37 (Kumar, 1977) which is much higher than the estimate in Mewati cattle.



10.2.5 Face length

The overall face length of calves below 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 26.55, 35.74, 37.93, 45.17 and 48.92 cm, respectively. The mean face length of adult cow varied from 42.6 cm in Mathura to 46.73 cm in Alwar district. Among the bullock group the mean face length was 47.5 cm in Mathura and 51.2 cm in Bharatpur district.

10.2.6 Ear length

The overall ear length of calves below 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 18.14, 21.58, 22.7, 25.32 and 25.77 cm, respectively. The mean ear length of adult cow varied from 24.95 cm in Bharatpur to 25.62 cm in Mathura district. Among the bullock group the mean ear length ranged from was 24.63 cm in Mathura to 27.60 cm in Bharatpur district.

10.2.7 Horn length

Overall horn length was 17.84 cm in cows and 40.75 cm in bullocks.

10.2.8 Tail length

The overall tail length of calves below 1 year, males (1 to 3 years), females (1 to 3 years), adult cows and bullocks were obtained as 43.59, 57.45, 62.96, 77.19 and 77.15 cm, respectively. The mean tail length of adult cows varied from 69.02 cm in Mathura to 83.13 cm in Bharatpur district. Among the bullock group the mean tail length was 69.75 cm in Mathura and 89.0 cm in Bharatpur district.

It was observed as the coefficient of variation in all the morpho-metric measurements of adult cows and bullocks was in the range 5.11 to 13.41% except for the horn length. A wide variation in the horn length of adult cows (34.23%) and bullocks (20.95%) was seen during the survey. The coefficient of variation in all the morpho-metric traits of other growing age groups was in the range from 9.76% to 20.09%. A wide variation in the data in the age group below 1 year was observed which is obvious as the growth of animals is faster in first year of the age.



11. Microsatellite marker based genetic characterization of Mewati cattle

For characterization of existing genetic variability in Mewati cattle, a panel of 25 bovine specific microsatellite markers (BM1824, CSSM08, CSSM33, CSSM60, CSSM66, ETH3, ETH10, ETH225, HAUT27, HEL01, HEL5, HEL09, ILSTS005, ILSTS006, ILSTS011, ILSTS033, ILSTS034, INRA05, INRA63, INRA35, MM8, MM12, TGLA53, TGLA122 and TGLA227) recommended in MoDAD project of FAO (1998) for cattle genetic diversity studies was selected.

Fresh blood samples were collected randomly from 50 genetically unrelated animals of Mewati cattle from its breeding tract in line with MoDAD recommendations (FAO, 1998). Genomic DNA was extracted from the whole blood using proteinase-K digestion followed by standard phenol-chloroform extraction procedure of Sambrook *et al.* (1989).

Polymerase Chain Reaction was carried out in 15 ml reaction volume containing 1.5 mM MgCl₂, 200 mM dNTPs, 5 mM of each primer, ~100 ng of template DNA and 1.0 U of Taq DNA Polymerase using PTC-200 thermocycler (MJ Research Inc., MA, USA). PCR cycling conditions were: 2 min at 94^o C, followed by 30 cycles of 1 min at 94^o C, 1 min at annealing temperature of each primer, 1 min at 72^o C and final extension of 10 min at 72^o C. One of the two primers used for amplification for a given locus was end labeled with one of the four fluorescent dyes viz., 6-FAM, VIC®, NED or PET. PCR amplified products (0.5 ml) were mixed with Hi Di formamide (9.2 ml), Liz standard (0.3 ml) and analyzed on ABI PRISM® 3100 DNA analyzer. Allele sizing for different DNA fragments was carried out utilizing the GeneScan software. Different measurements of within breed genetic variations were estimated using various population genetic softwares to assess the genetic diversity in Mewati cattle.

All the 25 loci amplified successfully and produced unambiguous alleles from which individual genotypes were assessed. Various genetic variability measures estimated for each locus viz., observed & effective number of alleles; observed & expected heterozygosity are shown in Table-1. The observed number of alleles (No) ranged from 4.00 (ILSTS011) to 13



(ILSTS034, TGLA53 and TGLA122). Effective number of alleles (N_e) was distinctly less than the observed values across all loci and varied from 1.7 (ILSTS011 and TGLA227) to 9.0 (TGLA122). Observed (H_o) and expected heterozygosities (H_e) varied from 0.273 (HEL5) to 0.872 (TGLA122) and 0.417 (TGLA227) to 0.898 (TGLA122), respectively. The mean observed heterozygosity values, though lower than the expected values, exhibited failure of significant differences using ANOVA test ($p > 0.05$) suggesting random mating in Mewati cattle. PIC values ranged from 0.365 (ILST011) to 0.888 (TGLA122) with a mean of 0.634. Based on the PIC values, nearly 88% of the markers were observed to be highly informative ($PIC > 0.50$) and only a few were reasonably informative ($0.50 > PIC > 0.36$), which indicated high utility of these markers for biodiversity evaluation in other native Indian cattle breeds as well.

The estimates of allele diversity (mean number of observed alleles per locus = 8.1; mean effective number of alleles = 3.7; gene diversity (mean expected heterozygosity) = 0.677 and mean PIC values = 0.634 revealed the presence of high genetic diversity in Mewati cattle (Table 1). The values of these diversity measures were in accordance with high estimates of genetic variability counts reported earlier in other native cattle breeds (Mukesh *et al.*, 2004; Sodhi *et al.*, 2005).

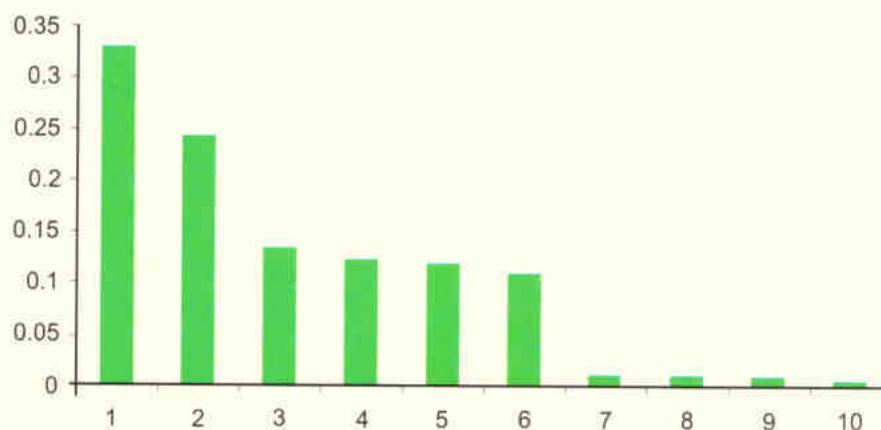


Fig.11- Mode-shift test for bottleneck in Mewati cattle



Table- 10 : Various diversity indices and size range at each micro satellite locus in Mewati cattle

Loci	Size Range (bp)	No of alleles		Heterozygosity		PIC	F _{IS}
		Na	Ne	Ho	He		
BM1824	178-198	5.0	2.3	0.438	0.574	0.499	0.240*
CSSM08	180-202	6.0	2.5	0.553	0.607	0.560	0.089
CSSM33	147-189	12.0	5.6	0.766	0.830	0.808	0.077
CSSM60	80-116	10.0	3.2	0.660	0.691	0.645	0.046
CSSM66	177-207	10.0	4.6	0.696	0.791	0.750	0.122*
ETH3	96-122	5.0	2.5	0.563	0.607	0.536	0.074
ETH10	187-223	6.0	3.9	0.804	0.750	0.699	-0.073
ETH225	132-158	9.0	2.5	0.638	0.608	0.578	-0.051
HAUT27	132-162	8.0	6.3	0.624	0.678	0.625	-0.012
HEL01	102-120	7.0	2.8	0.660	0.650	0.616	0.566*
HEL5	140-170	9.0	2.6	0.273	0.625	0.594	0.075
HEL09	137-169	10.0	4.6	0.612	0.681	0.636	-0.026
ILSTS005	156-208	5.0	4.2	0.787	0.768	0.719	0.142*
ILSTS006	276-310	9.0	2.3	0.489	0.569	0.530	0.223*
ILSTS011	249-277	4.0	1.7	0.333	0.428	0.365	0.226*
ILSTS033	131-163	8.0	2.8	0.500	0.644	0.572	0.100
ILSTS034	137-199	13.0	3.4	0.646	0.717	0.687	-0.038
INRA05	120-148	7.0	4.4	0.809	0.779	0.736	-0.036
INRA63	157-189	5.0	1.9	0.500	0.483	0.443	0.000
INRA35	91-135	8.0	6.5	0.854	0.854	0.826	0.163*
MM8	116-140	5.0	3.1	0.579	0.690	0.625	-0.000
MM12	101-129	9.0	4.6	0.792	0.791	0.756	0.032
TGLA53	146-186	13.0	4.6	0.766	0.791	0.763	0.029
TGLA122	134-166	13.0	9.0	0.872	0.898	0.888	0.294*
TGLA227	65-115	7.0	1.7	0.296	0.417	0.393	-0.016
Mean		8.1	3.7	0.620	0.677	0.634	0.084*

Na-observed, Ne-effective, Ho- observed, He- expected, PIC- Polymorphism Information Content, F_{IS} - within population inbreeding estimates



Within population inbreeding estimates (F_{IS}) for Mewati cattle is depicted in Table 10. Mewati cattle populations showed significant ($P < 0.05$) heterozygote deficit (8.2%). The average F_{IS} values for eight loci were significantly different ($p < 0.05$) from zero. A number of factors viz., inbreeding, locus under selection (genetic hitchhiking), null alleles (non-amplifying alleles), and presence of population substructure (Wahlund effect) may be responsible for the lack of heterozygote. Heterozygote deficiency analysis revealed deviations from HWE ($P < 0.05$) at some of the loci in Mewati cattle. It is, though, difficult to envisage the exact basis of this departure, however, the presence of low frequency null alleles segregating at these loci may be a possible reason. This deviation could also be linked to fairly high positive F_{IS} (within-population-inbreeding estimate) for these loci.

The outcome for IAM, SMM and TPM supported for the absence of any bottleneck in Mewati cattle. None of the estimated P values were significant ($P > 0.05$), indicating that the null hypothesis of mutation drift equilibrium is accepted in all the population. Also no Mode shift was detected in the frequency distribution of alleles and a normal L-shaped curve was observed, where the alleles with the lowest frequencies (0.01-0.1) were found to be most abundant (Fig.11).

The present analysis outlines the existence of sufficient genetic diversity and contributes to the knowledge of genetic structure of Mewati cattle. The data could be utilized in establishing the relationship with other Indian cattle breeds.

12. Performance

12.1 Production performance

The production performance of Mewati cattle under rural management conditions was reported by Singh and Pundir (2007). The milk production per day varied from 4 to 12 litres with an average of 6.2 litres based on 53 observations.



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The Lactation length varied from 150-250 days. Production performance was constant in first four lactations.

Bhasin (1969) analyzed the data of Cattle Breeding Farm, Kumher (district Bharatpur) for lactation yield, lactation period, dry period, productive ability. The most probable producing ability was calculated by using the formula as given given Lush (1945):



Fig.12 - Mewati cow recently calved

$$\text{Producing ability} = \text{Herd average} + \frac{n}{1 + (n-1)\alpha} * (\text{Cow's own average} - \text{herd average}),$$

Where α is the repeatability coefficient of the lactation yield and n is the number of lactations completed.

The averages along with deviation for the production traits are given in the table 11.

Table-11: Production traits in Mewati cattle. (Bhasin, 1969)

Trait	No. of Observations	Mean	S.D.	S.E.	C.V.
Lactation yield (kg)	316	958.20	349.41	19.65	36.66
Lactation period (days)	316	292.31	78.16	4.40	26.74
Dry period (days)	280	217.85	105.88	6.22	48.37
Productive ability (kg)	85	969.32	582.00	63.12	60.04

12.1.1 Lactation yield

The average lactation yield of Mewati cattle was reported as 953.2 ± 19.65 kg. The repeatability of this trait was recorded as 0.1869. By distributing the cows according to their average yield into nine classes of class interval of 100 kg, 48.2% of animals were found with the lactation yield above 1000kg. Joshi *et al* (1995) estimated the overall weighted average lactation yield as 996.87 kg ranging from 692.81 to 1753.46 kg in Haryana cattle based on various reports, which is slightly higher than lactation yield in Mewati cattle.



Fig.13(a-d)- Mewati cows

12.1.2 Lactation Period

The average lactation period of Mewati cattle was found to be 292.31 ± 4.40 days with a repeatability coefficient of 0.1190. For finding out the effect of lactation period on milk yield, the data was classified into lactation period of 14 groups with a class interval of 25 days and it was reported that the milk yield increases along with an increase in the lactation period. The correlation coefficient between these two traits was found to be 0.66, which was significant ($P < 0.01$). Joshi *et al* (1995) estimated the overall weighted average lactation period as 272.12 ± 0.91 days with a range from 237.91 to 330.09 days in Haryana cattle based on various reports, which is in close agreement with lactation period in Mewati cattle. The lactation milk production in cows is usually recorded for a period of 300 to 305 days but in Mewati and Haryana cows the lactation period usually falls below 300 days.



12.1.3 Dry period

The average dry period was found to be 217.85 ± 6.22 days which can be reduced for making the milk production economic. The repeatability of the trait was 0.1058 which was quite low. Therefore, the control of the trait is purely managerial and can be done by reducing the service period. Joshi *et al* (1995) estimated the overall weighted average dry period as 309.28 ± 4.01 days ranging from 133.03 to 571.44 days in Haryana cattle based on various reports, which is higher than dry period in Mewati cattle.

12.1.4 Producing ability

The producing ability of Mewati cattle was reported to be 963.32 ± 63.12 with a coefficient of variation as 60.04%. The high coefficient of variation indicated that there was sufficient scope of selection for improving the trait.

12.2 Reproduction traits

The reproduction traits of Mewati cattle were studied through survey of the breeding tract. The reproduction traits of the cows under rural management conditions is as under (Singh and Pundir, 2007) :

- **Age at first calving** - 3.5 to 4.5 years.
- **Number of service/conception** - 1 to 2.
- **Repeat breeders** - Only 3-5% cases
- **Inter calving period** varies 12- 18 months.
- **Service Period**- 3-9 months.

Bhasin (1969) studied the economic traits of Mewati cattle. The study included age at first calving, inter calving period and breeding efficiency on the records of cows maintained at Cattle Breeding Farm, Kumher (district Bharatpur). The



Fig.14- Mewati bull calf



breeding efficiency was worked out as formula described by Wilcox *et al* (1957) which is as under:

$$\text{Breeding efficiency} = 365 * (n-1) * 100 / D$$

Where n is the total number of calving and D is number of days from first to last calving. The averages along with deviation for the reproduction traits are given in the table 12.

12.2.1 Age at first calving

The age at first calving was reported to be very high (53.16 ± 1.30 months) with a coefficient of variation 21.84%. There is a need to improve this trait so as to make cows more economic. Joshi *et al* (1995) estimated the overall weighted average of age at first calving as 1566.82 ± 3.80 days which ranged from 1067.34 to 1808.8 days in Haryana cattle based on various reports, which is in close agreement with age at first calving in Mewati cattle.

12.2.2 Inter calving period

The average inter calving period was 503.99 ± 8.53 days with a wide coefficient of variation 28.67%. The repeatability of this trait was obtained to be 0.497. Joshi *et al* (1995) estimated the overall weighted average of inter calving period of Haryana cows at different farms as 482.73 ± 2.10 days with a range from 415.36 ± 4.13 to 561.11 ± 2.82 days based on various reports, which is in close agreement with inter calving period in Mewati cattle reported by Bhasin (1969).

12.2.3 Breeding efficiency

The breeding efficiency was found to be $68.62 \pm 1.38\%$, which is quite satisfactory (Bhasin, 1969).

Table-12: Reproductive traits in Mewati cattle. (Bhasin, 1969)

Trait	No. of Observations	Mean	S.D.	S.E.	C.V.
Age at first calving (months)	40	53.16	11.61	1.30	21.84
Inter calving period (days)	280	503.99	144.52	8.53	28.67
Breeding efficiency (%)	85	68.62	12.69	1.38	18.49



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Fig.15(a-b)- Mewati calves



Fig.16- Mewati cow with calf



Fig.17- Mewati cow with heifer



12.3 Draft performance

The Mewati bullocks are in general sturdy, powerful and docile and are useful for heavy ploughing, carting and drawing water from deep wells. Bull calves are generally castrated when they cross two years of age and put for light work. The bullocks are supposed to work with their full capacity when they attain 4-5 years of age. A pair of bullocks can haul about 1,200 to 1500 pounds of load in an iron-rimmed cart at an average speed of 3 miles per hour, a distance of 15 to 20 miles per day. In fieldwork, they have capacity to work for a period of 8 to 10 hours per day. The draft utility is reducing very fast in last two to three decades due to farm mechanization in the area.



Fig.18- Mewati bullock pairs

13. Breeding Farms

There is no breeding farm of this breed in the country but some *Gaushalas* are maintaining the breed. There were many *gaushalas* in the area especially in Mathura keeping some good animals also but generally meant for keeping unproductive animals due to religious reasons.

14. Recommendations

1. A detailed survey of entire breeding tract of Mewati cattle is needed so as to characterize and evaluate the breed in its native tract. An approximate population may also be estimated. The state Animal Husbandry department may take up this task.
2. The bulls of elite females in the field need to be selected and reared. Subsequently, such bull may be used in the breeding of field animals either through AI or natural service.



3. The breeding of Mewati cattle by semen of exotic/other breed's bull may be stopped immediately.
4. One Livestock Farm of Mewati Cattle may be established in the main breeding tract preferably at Alwar district of Rajasthan with following objectives:
 - a. To act as nucleus herd of Mewati cattle for genetic improvement.
 - b. To identify elite bull calves from the field, rear them and supply them in the field for breeding purpose.
 - c. To carry out a progeny testing programme for production of proven bulls.
 - d. To act as demonstration unit for the farmers.
 - e. To train the farmers for cattle husbandry practices.
5. The artificial insemination facility using Mewati bulls should be initiated in the entire breeding tract of this breed.
6. Mewati Cattle Breed society should be formed for the development of the breed in the breeding tract and protection of farmers' rights in the breeding tract.
7. Provisions should be made to castrate the non-descript males through legislation and it should be strictly implemented to check the indiscriminate breeding.
8. Some cattle fairs may be regularly organized in the breeding tract to encourage the farmers keeping good Mewati cows and to interact with them so as to know their problems. Some animal health camps and *Kisan Gosthis* may also be arranged in the breeding tract. The farmers may be explained the value of this precious germplasm and benefits of keeping Mewati as compared to crossbred with resource poor farmers.

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Published by : Director, NBAGR

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