MONOGRAPH-2010

Buffalo Genetic Resources of India

MARATHWADI

National Bureau of Animal Genetic Resources

(Indian Council of Agricultural Research)

P.B. No. 129, G.T. Road Bypass

Karnal-132001, Haryana

MONOGRAPH-2010

Buffalo Genetic Resources of India

MARATHWADI

National Bureau of Animal Genetic Resources
(Indian Council of Agricultural Research)
P.B. No. 129, G.T. Road Bypass
Karnal-132001, Haryana

Published by : Dr. B.K. Joshi
Director
National Bureau of Animal Genetic Resources
P.O. Box No. 129, Karnal - 132 001 (Haryana)

ISBN :

Cover Design :

Printed by : Glam Media
SCO 3, Level 2, Sector 8,
Karnal - 132 001

CONTENTS

1. Sample text 00

PREFACE

Livestock has been an integral component of traditional agriculture since time immemorial. In India, buffaloes play pivotal role in livestock production through contributions in terms of milk, meat, hide and draft power for agricultural operations. India is habitat of the best riverine breeds of buffalo in the world. Marathwada breed of buffaloes represent a very ancient indigenous type characterized with lighter built and long flat horns. The breeding tract of this buffalo lies in Marathwadi region of Maharashtra. These buffaloes are reared in low external input system mainly due to their low maintenance cost, feed conversion efficiency, moderate production and ability to thrive in harsh climatic conditions. The breed is primarily maintained by small and marginal farmers and landless labourers mostly for their moderate milk production which vary from four to eight kg per day. Lack of awareness regarding pure breeding resulted in the dilution of this important germplasm. It is high time to evaluate and characterize this important genetic resource so as to plan for its systematic genetic improvement and conservation.

This bulletin is compilation of information on production and reproduction performance of Marathwadi buffaloes along with its morphological characteristics and genetic diversity. The authors wish to thank Dr. B.K. Joshi, Director, NBAGR for taking initiatives in compiling and updating the information available for this important buffalo breed. The authors hope and trust that the bulletin will be useful to the policy makers, researchers and students in getting glimpses of this important buffalo breed.

Authors

INTRODUCTION

Indian riverine buffaloes contribute immensely to the rural economy by producing more than 50% of the total milk in the country. These buffaloes have adapted to the existing ecosystem over the years and have gained prominence as an important dairy animal. There are ten well defined breeds viz. Murrah, Nili-Ravi, Jaffarabadi, Surti, Mehsana, Bhadawari, Nagpuri, Pandharpuri, Marathwada and Toda which have been classified into five different groups based on geographic location (Cockrill, 1974). However, approximately 70% of the total 94 million heads have been grouped into non-descript type (Acharya and Bhat, 1984). All the above breeds have evolved over the years as a result of traditional animal breeding practices of small and marginal farmers in the respective areas. Buffaloes in North and North West India like Murrah, Nili-Ravi and Mehsana were developed for high milk production. Murrah, the best dairy type buffalo is widely used for grading up the non-descript as well as other local breeds (George et al. 1988). This has resulted in the dilution of many distinguished breeds which have adapted to their respective agro-climatic conditions and having been used for many other purposes like draught, hide and dung.

Marathwada breed of buffaloes represent a very ancient indigenous type characterized with lighter built and long flat horns. Marathwada buffaloes are reared in low external input system mainly due to their low maintenance cost, feed conversion efficiency, moderate production and ability to thrive in harsh climatic conditions. The breed is primarily maintained by small and marginal farmers and landless labourers mostly for their moderate milk production which vary from four to eight kg per day.

Breeding Tract and Ecological Settings

Marathwadi buffaloes are found in the Marathwada region of Central India especially in Parbhani, Nanded, Bid, Hingoli and Latur districts of Maharashtra state.

Location: Maharastra is the third largest state in terms of area and population in the country and forms a major portion of peninsular India. Marathwada revenue division of Maharastra state was part of erstwhile Nizam state surrounded by Telangana (Andhra Pradesh) on eastern and southern sides, Vidarba region on northern side and western Maharastra on west. This revenue division is comprised of eight districts viz. Aurangabad, Jalna, Parbhani, Beed, Osmanabad, Latur, Nanded and Hingoli district. (Figure 1). It lies between 170 35'N and 200 40'N latitude and between700 40' E and 780 15'E longitude in the Deccan Platue Zone. Except for some industrialization around Aurangabad and Nanded, the entire breed tract has rural setting.

Figure 1. Native breed tract of Marathwada buffaloes

Soil: The Marathwada region is a flat terrain with retentive black soil classified as vertisols. The fertility index with respect to nitrogen is low in Parbhani, Hingoli and Nanded district while it is medium in Aurangabad, Jalna, Beed, Osmanabad, and Latur districts. In case of phosphorus, the fertility index is low in the entire district expect six tehsils of Jalna and Beed district while it is very high for potash in almost all the districts of Marathwada region. Average use of fertilizer is 50 Kg N and 39 Kg P2O5 per hectare. The deficiency of micronutrients viz. Zn and Fe is noticed in high intensity cropping.

Climate: Climatologically Marathwada is categorized as semi-arid on annual basis, as the Precipitation Effectiveness Index (PEI) ranges from 35 to 45 on temporal scale. It is humid to pre-humid during monsoon (June-September), sub-humid to semi-arid during winter (October-February) and arid during summer (March-May) season. The corresponding distribution pattern of annual rainfall (rainfall (500-1000) mm is 78-85, 10-15 and 6-10 per cent, respectively. The wet monsoon period alternates with long rain free cold winter (minimum temperature 12-180C) and summer (maximum 40-550C) having appreciable temporal and spatial variability, a typical characteristic of semi-arid climate.

Crops and Cropping Pattern: A large portion of the land in Marathwada represents Kharif-rabi continuum. Sorghum, pearl millet, cotton pigeon pea, sunflower, groundnut, mungbean, urdbean, soybean, sesamum and maize are the kharif crops while, wheat, gram, safflower and now sunflower, groundnut dominate the post-raining cropping. Cotton is the important crop of the region while banana and sugarcane are the cash crops grown on limited irrigated areas. The fruits requiring high to no water viz. sweet oranges, papaya, sapota, fig, guava, ber, mango, tamarind are also observed.

Population status of buffaloes in the breeding tract

According to 17th Livestock census (2003), the cattle and buffalo population of Maharashtra state is 16.3 and 6.15 millions respectively. The trend of buffalo population in the state showed a marginal increase of 1.19% while cattle population declined by 9.8% from 1997 to 2003. There are three buffalo breeds indigenous to Maharashtra state viz. Pandharpuri, Marathwadi and Nagpuri. Apart from these native breeds, prominent buffalo breeds of other states like Murrah, Surti and Jaffarabadi are also reared by the farmers. Among the buffalo breeds of Maharashtra, Pandharpuri buffaloes constitute 9.90% of total buffalo population followed by Marathwadi and Nagpuri with 6.99% and 6.95% respectively while more than 60% of buffaloes are non-descript. The percent contribution of different breeds to total buffalo population of Maharashtra is given in the Table 1 (Gujar, 2007).

Table Breed-wise buffalo population in Maharashtra state

Breed	Total		Rural	
	Population	%	Population	%
Pandharpuri	601,445	9.90	552,664	9.32
Marathwadi	425,051	6.99	399,357	7.12
Nagpuri	422,436	6.95	387,330	6,91
Murrah	380,129	6.25	329,178	5.87
Surti	374,622	6.17	271,721	4.85
Jafarabadi	152,004	2.50	120,658	2.15
Local/N.D.	3717,001	61.24	3545,263	63.78
Total	6072688	100.00	5,606,171	100.00

In the Marathwada region of Maharashtra, Marathwadi buffalo is the major breed constituting about 32% of buffalo population. During the survey of breed tract in the districts of Beed, Jalna, Parrbhani, Latur and Nanded districts, Gujar (2007) reported that the percent contribution of Marathwadi buffalo breed varied from 34.73% (Jalna district) to 87.60% (Latur districts) of the total buffalo population in the respective districts (Figure 2). Extrapolation by superimposing survey data on 16th Livestock census data, Gujar (2007) reported the population of Marathwadi buffaloes as 1,98,658 in three districts viz. Beed, Jalna and Parbhani districts.

Figure 2. Percent Marathwadi buffaloes among total buffalo population in different districts of the breed tract

HUSBANDRY PRACTICES

Buffalo Holding Size

The number of buffaloes reared per family was mostly one, with 73 percent of farmers possessing only single buffalo. About 21% of the farmers possess two buffaloes, 3.75 % possess three buffaloes while only 0.70% rear four buffaloes. The percent farmers rearing single buffalo was 86.41 under landless category, 70.83 among those possess four to six hectares of land while it was 56.09 percent among farmers who possessed more than six hectares of land.

Housing management

District-wise information on housing of buffaloes is given in table 2. The buffaloes are provided some housing mostly during night hours (98.5 per cent). The housing is mostly open (84.99 per cent) and Kutcha (95.4 per cent). Normally the animal houses were separate (90.4 per cent) except in certain households where it forms part of owner's residence. Most of the houses were Kutcha with lack of proper flooring (93.30 per cent) half walled (87.30 per cent) or without urine drain. Buffaloes go for wallowing in canals, river or tanks mostly during noon hours (93.21 per cent) (Figures 3,4 & 5).

Feeding management

Grazing: The animals are sent for grazing on available grasslands both in the morning and evening. During noon time, the buffaloes were allowed for resting in the fields. The buffaloes roam around four km on an average daily (morning and evening) and spend more than six hours outside the village for grazing. The grazing distance and time increased during summer, while it reduced during monsoon season depending on the availability of grazing areas (Figures 6,7 &8).

Feed and Fodder : None of the buffalo was stall fed either individually or in a group. The grasses were from non-cultivated sources i.e. bund grass, community grazing grounds, etc. The area under forage crops in the breed tract is low as most of the farmers feed their animals with crop residues.

Figure 3.
Typical animal house in the breed tract as part of residence

Figure 4.
Typical housing for Marathwadi buffaloes separate from residence

Figure 5.
Housing with Kutcha floor and poor drainage facilities

Figure 6.
Marathwadi buffaloes move upto 4 kms daily for grazing

Figure 7.
Marathwadi buffaloes grazing in the fields

Figure 8.
Fallow lands available for grazing in the breed tract

Table 2 Proportion of farmers providing different housing conditions to Marathwadi buffaloes in different districts of the breed tract

Housing Provisions	Beed	Jalna	Latur	Nanded	Parbhani	Pooled
Only during day	8	6	--	--	8	22 (1.30)
Only at night	602	408	138	153	629	1930 (98.50)
Both day and night	4	--	--	--	3	7 (0.20)
Open housing	459	380	120	148	558	1665 (84.99)
Closed housing	155	33	18	05	82	294 (15.10)
Kutcha house	565	394	138	149	623	1869 (95.40)
Pucca house	49	20	--	04	17	290 (4.60)
Separate animal house	534	392	125	146	574	1771 (90.40)
Part of residence	90	22	13	07	65	188 (9.60)
Kutcha floor	556	392	136	146	595	1828 (93.30)
Pucca floor	58	22	02	07	45	131 (6.70)
Fully walled	82	17	08	--	141	248 (12.70)
Half walled	532	397	130	153	499	1711 (87.30)
Good ventilation	549	400	130	151	578	1808 (92.30)
Bad ventilation	65	14	08	02	62	151 (7.70)
Good sanitation	514	260	135	149	500	558 (79.50)
Poor sanitation	100	154	03	04	140	401 (20.50)
Kutcha urine drain	216	145	09	07	179	556 (28.38)
Pucca urine drain	398	269	129	146	461	1403 (71.62)

Note: Figures in parenthesis indicate percentages

To a limited extent i.e. only 8.62 percent farmers were cultivating some forage crops for their buffaloes. The proportion of farmers in the breed tract devoting an area of 0.50 ha, 0.75 ha and more than 0.75 ha for forage production, was only 5.40, 1.89 and 1.33 percent, respectively. Most of the farmers were feeding limited quantities of green and dry fodder to the buffaloes. These greens constitute mostly by-products of crops or material out of crop failures (83.20 per cent).The crop residues of cereals (paddy jowar, bajra, maize) and pulses (pigeon pea, soybean, sunflower, gram, etc) are used as dry fodder for buffaloes.

Table 3. Daily feed and fodder offered to Marathwadi buffaloes in their breed tract

Particulars		Percentage of Farmers				
Fodder	Qty	Nil	Below 2.0	2.1 to 4.0	4.1 to 6.0	Above6.1
Dry Fodder	Nil	-	-	-	-	-
	1.0-5.0	96.1 0	46.40	48.80	45.80	39.20
	5.1-10.0	3.90	53.60	51.20	54.20	65.00
	> 10.0	-	-	-	-	5.80
Green Fodder	Nil	-	-	2.43	-	-
	1.0-5.0	76.90	57.14	41.40	25.00	36.50
	5.1-10.0	23.10	42.70	53.60	75.00	63.50
	> 10.0	-	0.16	3.57	-	-

The quantity of dry and green fodder fed to Marathwadi buffaloes in relation to farm size in the breed tract is given in Table 3. Most of the land-less farmers (96.10 per cent) feed their buffalo with 1 to 5 kg dry fodder. The quantity of dry fodder provided to the buffaloes increased with increase in size of land holding. Farmers possessing more than six hectares of land were giving more than 10 kg of dry fodder to their buffaloes. With respect to green fodder, 76.90 per cent of landless farmers were feeding 1 to 5 kg of green fodder mostly by purchasing from other farmers who possess lands. The quantity of green fodder offered to buffaloes increased with increase in landholding size of the farmers. The concentrates were also fed to milch buffaloes round the year and irrespective of land holding. Most of the farmers give 1.5 to 3 kg of concentrates to the buffalo every day. Among different categories of farmers possessing land, about 10% to 30% were found to give 3 to 4 kg of concentrates to their buffaloes daily.

Nutritional Status of lactating Marathwadi buffaloes

The nutritional status of lactating Marathwadi buffaloes in the breed tract was found to be mostly deficient. With the assumed body weight of 400kg, there was deficiency in dry matter, DCP and TDN contents of the feed provided to Marathwadi buffaloes. The dry matter was deficient by 8.50 to 38.20 per cent, DCP by 3.98 to 24.27 per cent and TDN by 4.80 to 20.80 per cent among different categories of farmers (Table 4).

Figure Marathwadi buffalo calf

Table 4. Nutritional status of lactating Marathwadi buffaloes in the breed tract.

Particulars	Farmers' land holding (in ha)				
	Land Less	Below 2.0	2.1 to 4.0	4.1 to 6.0	Above 6.1
Average daily milk yield / animal (litres)	3.40	4.28	4.14	4.28	4.34
Dry matter requirement (kg)	10.00	10.00	10.00	10.00	10.00
Dry matter provided (kg)	6.18	6.89	7.65	8.60	9.10
Deficiency (-) / surplus (+) (kg)	-3.82	-3.11	-2.35	-1.40	-0.80
Percent deficiency (-) / surplus (+)	-39.20	-31.00	-23.00	-14.00	-8.50
DCP requirement (kg)	0.464	0.519	0.532	0.519	0.522
DCP provided (kg)	0.418	0.393	0.452	0.551	0.501
Deficiency (-) / surplus (+) (kg)	-0.046	-0.126	-0.08	+0.300	-0.020
Percent deficiency (-) / surplus (+)	-10.00	-24.27	-15.03	+6.16	-3.98
TDN. Requirement (kg)	4.56	4.96	4.76	4.96	4.99
TDN provided (kg)	3.71	4.05	4.53	5.17	5.35
Deficiency (-) / surplus (+) (kg)	-0.98	-0.91	-0.23	+0.21	+0.36
Percent deficiency (-) / surplus (+)	-20.80	-18.37	-4.80	+4.23	+7.21

Physical characteristics of Marathwadi buffalo

Marathwadi buffaloes are of light to medium built with compact stature. The coat colour is predominantly black (97.7%) and to some extent jet black (2.1%). Grey coloured animals are found rarely in the breed tract, although white markings on forehead and switch of tail are not uncommon. The skin colour is mostly jet black (97.6%) with some black (0.2) and grey (0.1%) animals. The pattern of muzzle colour resembles coat or skin colour with most buffaloes having black or jet black muzzle. The eyelids are predominantly black (90.1%) with variations of jet black (5.1%), grey (4.3%) and white (0.5%) colours (Table 5. Forehead is moderately broad with the peculiar white patch found in about 18.5% of buffaloes. The eyes appear dull during early age and become glossy as the age advances. The pupil colour is either black (59.8%) or brown (20.6%) and white (11.6%) (Table 7).

Neck is short. Horns are medium in length, parallel to neck, reaching up to shoulder but never beyond shoulder blade as found in Pandharpuri buffaloes. The diameter and base of the horn is 14.4 ± 1.6 cms and 20.3 ± 2.8 cms in buffaloes of 1-3 years and above 3 years of age respectively (Table 6).

Figure 10. Female Marathwadi buffalo with white marking on forehead

Figure 11. Breeding male of Marathwadi breed

Figure 12. Typical horn pattern in Marathwadi buffalo

The shape of udder is normally round (62.1%), while trough, bowl and pendulous udder are found to the extent of 17%, 12.8% and 8.1% of buffaloes respectively. The milk vein in Marathwadi buffaloes is not very prominent. The shape of teat is cylindrical in 45.6% of cases, funnel shaped in 41.3% and pear shaped in 13.2% of Marathwadi buffaloes. The teat tips are round in 62.4% cases and pointed in 31.7% of Marathwadi buffaloes. 58.6% of buffaloes have their teats squarely placed while wide placement of fore and rear teats are found in 35.1% and 6.3% of buffaloes respectively.

Table 5. Colour pattern of different body parts in Marathwadi Buffalo

Characteristics	Colour	N	Percent Buffaloes
Coat colour	Jet black	73	2.1
	Black	3377	97.7
	Grey	6	0.2
Skin	Jet black	76	2.2
	Black	3374	97.6
	Grey	6	0.1
Muzzle	Jet black	76	2.2
	Black	3352	95.2
	Grey	28	0.8
Eyelids	Jet black	176	5.1
	Black	3114	97.0
	Grey	149	4.3
Hooves	White	17	0.5
	Jet black	28	0.8
	Black	3325	96.2
	Grey	97	2.8
Tail	White	6	0.2
	Jet black	176	5.1
	Black	2308	66.8
	Grey	55	1.6
	White	91	26.5
Horns	Black	3342	96.7
	Brown	114	3.3

Note: Figures in parenthesis indicate percentage

Table 6. Horn pattern of Marathwadi buffalo under different age groups

Characteristics	Pattern	Age in months		Total (2464)
		12 - 3 6 (346)	above 36 (2118)	
Lenqth (cm)	-	28.9 + 6.3	43.7 + 7.2	-
Diameter at base (cm)	-	14.4 + 1.6	20.3 + 2.8	-
Placement at base	Wide	223 (84.15)	1765 (95.97)	1988 (94.49)
	Close	42 (15.85)	74 (4.03)	116 (5.51)
Shape	Curved	257 (96.58)	1737 (94.46)	1994 (94.77)
	Straight	08 (3.02)	102 (5.54)	110 (5.23)
Orientation Parallel to neck	Yes	122 (46.04)	1702 (92.55)	1824 (86.70)
	No	143 (53.96)	137 (7.45)	280 (13.30)
Straight way going back	Yes	208 (78.49)	1519 (82.60)	1727 (82.08)
	No	57 (21.51)	320 (17.40)	377 (17.92)
Below neck	Yes	162 (61.31)	1284 (69.82)	1446 (68.72)
	No	103 (38.87)	555 (30.18)	658 (31.58)
Curved end	Yes	82 (30.90)	234 (10.28)	316 (15.02)
	No	183 (69.10)	1605 (89.72)	1788 (84.98)
Extended beyond hump	Yes	72 (27.17)	47 (2.56)	119 (5.66)
	No	173 (72.83)	1792 (97.44)	1985 (94.34)
Thickness	Thick	17 (07.80)	47 (2.56)	65 (3.09)
	Medium	172 (64.90)	1623 (88.25)	1795(85.31)
	Small	75 (28.30)	169 (9.19)	244 (11.60)

Note: Figures in parenthesis indicate percentage

Table 7. Pattern of various parts of head in Marathwadi buffalo

Characteristics	Pattern	Age in months					Pooled (3456)
		1-3 (469)	3-6 (304)	6 -12 (219)	12 - 36 (346)	above 36 (2118)	
Ear length	Length in cm	13.40 + 2.83	16.25 + 1.62	18.35 + 2.40	20.89 + 4.23	25.68 + 3.56	-
Ear orientation	Horizontal (%)	2.4	4.0	0.9	2.1	4.7	3.9 (135)
	Dropping (%)	97.7	96.1	99.1	98.0	95.1	96.1 (3321)
Eyes	Glossy (%)	39.1	42.9	80.0	85.7	77.6	74.2 (2464)
	Dull (%)	60.9	57.1	20.0	14.3	22.4	25.8 (892)
Pupil Colour	Black (%)	24.3	28.6	65.0	63.2	64.3	59.8 (2067)
	Brown (%)	37.8	46.4	10.0	10.5	18.3	20.6 (712)
	White (%)	24.3	14.3	10.0	5.3	10.9	11.6 (401)
	Other (%)	13.5	10.7	15.0	21.1	6.5	8.0 (276)
Straightness of nasal bridge	Yes (%)	97.7	96.4	99.1	98.6	96.8	97.1 (3356)
	No (%)	2.3	3.6	0.9	1.4	3.2	2.9 (100)
White patch on forehead	Yes (%)	1.9	12.6	14.6	7.5	11.3	18.5 (639)
	No (%)	98.1	87.4	85.4	92.5	88.7	81.5 (2817)

Body measurements

Average birth weight of male and female calves is 24.5 kg and 23.7 kg respectively. The average body measurements of male and female Marathwadi buffalo in various age groups are presented in Table 8. The heart girth, body length, height at withers and height at pin bones in adult she-buffalo is 181.64, 128.52, 124.35 and 116.09 cms respectively. The average length of horns is found to be 28.9 + 6.3 cms in buffaloes of one to three years of age while it is 43.7 + 7.2 cms in buffaloes more than three years of age. The tail length in adult Marathwadi buffalo is 65.54 + 0.64 cms. The tail reaches up to hock joint in most cases (95.6%) and is well above fetlock joint.

Table 8. Average body measurements in various age groups of Marathwadi buffaloes

Sr. No.	Trait	Months				
		1-3	3-6	6-12	12-36	36 and above
Female	N	283	247	195	315	2106
	Chest girth (cm)	78.22	99.01	111.89	129.52	181.64
	Body length (cm)	56.90	73.40	82.78	97.68	128.52
	Height at withers (cm)	69.00	84.01	90.64	99.79	124.35
	Height at pin bones (cm)	64.56	78.53	84.07	93.00	116.09
Male	N	186	57	24	31	12
	Chest girth (cm)	82.60	94.35	114.06	148.88	187.12
	Body length (cm)	60.71	70.05	84.81	107.75	149.00
	Height at withers (cm)	70.12	78.85	94.00	111.50	133.00
	Height at pin bones (cm)	66.33	75.65	88.81	107.13	128.00

PRODUCTION PERFORMANCE

Milk yield

The average lactation milk yield in Marathwadi buffaloes was 1118.4 litres which varied from 465 litres to 2676 litres under field conditions. The mean first lactation milk yield was 1080.55 litres which increased up to third lactation and started declining from fourth lactation onwards (Figure 13). The district-wise mean lactation milk yield was 1076.35, 1129.16, 1133.66, 1145.43 and 1221.76 litres in Parbhani, Latur, Jalna, Beed and Nanded districts respectively.

Figure 13. Mean lactation milk yield in Marathwadi buffaloes under field conditions

The average milk yield per day in a lactation period varied from 3.25 litres to 3.72 litres during different lactations. The mean peak yield varied from 4.98 litres to 5.93 litres per day which was achieved in 33 to 58 days after calving (Table 9). The lactation length varied from 157 to 493 days among different lactations with an overall mean of 318 days. The mean monthly milk yield of Marathwadi buffaloes was 115.79 litres during first month of lactation and increased to 140.76 litres during the third month which subsequently started declining gradually to 53.17 litres in tenth month and 31.21 litres in 12 month of lactation (Figure 14).

Table 9. Average lactation length and peak milk yield in different lactations of Marathwadi buffalo

Lactation	N	Lactation length	Average milk yield/day	Peak milk yield	Days required to reach peak milk yield
I	243	317.66	3.40	5.19	45
II	547	317.51	3.47	5.93	38
III	538	311.86	3.71	5.65	33
IV	216	308.67	3.72	5.68	52
V	90	322.92	3.25	5.26	58
VI	20	299.60	3.29	4.98	35
Overall	1654	317.90	3.52	5.47	40.28

Figure 14. Average monthly milk yield of Marathwadi buffaloes under field conditions

Reproduction Characteristics

The mean age at first oestrus in Marathwadi buffalo was 40.67 months under field conditions as reported by the farmers. The average age at first mating and age at first calving was 42.26 and 52.30 months respectively. The mean age at first calving of Marathwadi buffaloes recorded in different districts of breed tract varied from 51.14 months to 53.12 months. The mean duration of oestrus period was 25.23+0.13 hours which varied from 14to 40 hours. The duration of oestrus cycle ranged between 18 to 26 days in Marathwadi buffalo. The mean number of services required per conception was 1.76+0.02. Most of the farmers resort to natural service rather than artificial insemination of their buffaloes.

Table 10. District-wise and parity wise mean service period, dry period and calving interval in Marathwadi buffaloes

Details		N	Service period (days)	Dry period (days)	Calving Interval (days)
District	Beed	49	193.04	187.70	510.94
	Jalna	222	187.07	195.23	500.46
	Latur	61	202.40	201.06	514.34
	Nanded	15	166.97	167.64	478.60
	Parbhani	105	184.61	182.84	498.87
Parity	I	84	188.12	191.55	509.21
	II	149	187.89	183.42	500.93
	III	138	190.07	192.52	504.38
	IV	60	178.44	182.55	491.22
	V	16	180.21	171.82	494.74
	VI	5	186.26	199.03	498.63
Overall	-	452	187.53	184.07	501.97

The mean service period in Marathwadi buffaloes was 187.53 days among different lactations. The mean service period reported by farmers in different districts of breed tract varied between 167 days (Nanded) to 202 days (Latur). The mean dry period was 184.07 days which varied from 167.64 days to 201.06 days among different districts. The mean inter-calving period of Marathwadi buffaloes was 501.97 days (Table 10).

Seasonality of calving

The number of calvings in Marathwadi buffaloes during different seasons is presented in Table 11. Season was found to have a strong influence on the calvings of Marathwadi buffalo. Most of the calvings took place in monsoon (July-October) and winter (November-February) seasons. The percent calvings recorded during monsoon, winter and summer seasons were 43.29%, 40.76% and 15.95% respectively under field conditions (Figure15).

Table 11. Season-wise calving of Marathwadi buffalo recorded in the breed tract

Sr. No.	Centre	Mar-June (Summer)	July-Oct (Monsoon)	Nov-Feb (Winter)	Total
1.	Kolha	20	14	75	109
2.	Charthana	3	34	37	74
3.	Hatta	39	64	75	178
4.	Golegaon	24	26	26	76
5.	Goregaon	37	18	39	94
6.	Badnapur	29	05	38	72
7.	Navha	33	09	47	89
8.	Ran j ani	35	50	63	148
9.	K P gaon	38	21	48	107
10.	Mahora	05	36	35	76
11.	Ambaiogai	16	16	25	57
12.	Telgaon	08	46	40	94
13.	N Rajuri	10	17	25	52
14.	Khamgaon	09	32	10	51
15.	Bramhgaon	05	20	23	48
16.	Ahmedpur	05	56	10	71
17.	Loha	09	61	32	102
	Total	**239**	**649**	**611**	**1499**

Figure 15. Percent calvings during different seasons in Marathwadi buffalo

Genetic characterization of Marathwadi buffaloes using microsatellite markers

Basic diversity indices

Genetic characterization of Marathwadi buffaloes was carried out at Buffalo Genomics Laboratory, NBAGR, Karnal using a set of 24 heterologus microsatellite markers. A total of 48 animals were utilized to generate microsatellite genotypic data. The estimated values of different measures of genetic variation in Marathwada buffaloes viz. observed and effective number of alleles, observed and expected heterozygosity and heterozygote deficiency across 24 loci are presented in Table 12. The overall mean polymorphism information content was estimated to be 0.565 and it varied from 0.258 (BM 1818) to 0.767 (ILSTS 036) (Figure 16).

Figure 16. Polymorphism information content of different microsatellite markers in Marathwadi buffaloes

Genetic markers with PIC values of less than 0.25 are considered to be less informative and those with values more than 0.5 are reckoned as distinctly informative in population genetic studies (Botstein et al, 1980). Almost all the marker loci showed PIC values greater than 0.25, indicating their suitability for assessing genetic variation. With the exception of ILSTS 029, ILSTS 028, ILSTS 045, ILSTS 030, ILSTS 073, ISLSTS 017 and ILSTS 068, all the remaining 17 loci were highly informative with PIC values more than 0.5. A total of 109 distinct alleles were identified in Marathwada buffaloes. Allelic polymorphism varied from 2 (ILSTS 045, ILSTS 073) to 8 (HEL 013) with a mean number of 4.48 alleles per locus. The effective number of alleles was distinctively less than the observed value across all the loci and ranged between 1.42 (BM 1818) to 4.96 (ILSTS 036) with a mean of 2.93 (Kathiravan et al. 2009).

The observed and expected heterozygosity (Nei, 1973) varied between 0.089 (BM 1818) to 1 (ILSTS 019) and 0.299 (BM1818) to 0.807 (ILSTS 036) respectively across different loci. The overall mean observed and expected heterozygosity were found to be 0.532 and 0.624 respectively. The

mean observed heterozygosity in Marathwadi buffaloes was lower than that reported in other buffalo breeds (Arora et al. 2004; Kumar et al. 2006; Soysal et al. 2005). Marathwada buffaloes thus had a moderate amount of genetic variation derived from its gene diversity as judged against the genetic variation observed in other buffalo populations.

Table 12. Measures of genetic variation across 24 microsatellite loci in Marathwadi buffaloes

Locus	N	na	ne	Heterozygosity			FIS
				Ho*	He*	Nei's He	
ILSTS058	45	6	3.80	0.533	0.745	0.737	0.286
CSSM066	42	4	2.83	0.548	0.655	0.647	0.165
ILSTS025	47	5	3.48	0.596	0.720	0.713	0.175
HEL013	43	8	4.42	0.535	0.783	0.774	0.319
ILSTS052	46	7	4.64	0.544	0.793	0.785	0.317
ILSTS029	47	3	1.88	0.638	0.472	0.467	-0.357
ILSTS089	46	5	4.26	0.652	0.774	0.765	0.158
ILSTS061	46	5	2.37	0.674	0.584	0.578	-0.156
CSRM060	43	6	3.28	0.535	0.704	0.696	0.242
ILSTS056	46	5	2.00	0.544	0.505	0.500	-0.077
ILSTS028	47	4	1.70	0.532	0.415	0.410	-0.286
ILSTS045	47	2	1.94	0.149	0.491	0.486	0.699
ILSTS030	44	4	2.03	0.523	0.513	0.508	-0.019
ILSTS073	46	2	1.81	0.413	0.452	0.447	0.087
ILSTS026	45	4	2.72	0.644	0.639	0.632	-0.009
ILSTS019	47	4	2.56	1.000	0.616	0.610	-0.634
ILSTS095	43	5	4.64	0.698	0.794	0.785	0.122
ILSTS036	48	6	4.96	0.750	0.807	0.798	0.071
ILSTS017	44	3	2.01	0.619	0.509	0.503	-0.220
ILSTS060	46	5	2.95	0.544	0.668	0.660	0.188
ILSTS031	48	4	3.11	0.375	0.685	0.678	0.455
ILSTS033	43	4	2.49	0.256	0.605	0.598	0.580
ILSTS068	34	5	3.72	0.382	0.742	0.731	0.489
BM1818	45	3	1.42	0.089	0.299	0.296	0.705
Mean	-	4.48	2.93	0.532	0.624	0.617	0.138

N = No. of observations; na = Observed no. of alleles; ne = effective no. of alleles; FIS =Within population inbreeding estimate

Test for Hardy-Weinberg equilibrium

The average inbreeding coefficient (FIS) was high with significant deficit ($P<0.01$) of heterozygotes in Marathwada buffaloes. The FIS estimates varied from -0.634 (ILSTS 029) to 0.705 (ILSTS 068) with a mean positive value of 0.138 (Table 12). Thus it was observed that there exists 13.8% deficiency of heterozygotes in this buffalo population. Majority of the loci (16/24) contributed for this heterozygote deficiency with eight loci (ILSTS 045, ILSTS 035, ILSTS 033, ILSTS 068, ILSTS 058 HEL 013, ILSTS 052 and BM 1818) accounting for more than 25% each.. The test for H-W equilibrium (HWE) showed that several of the loci except seven (CSSM 066, ILSTS 061, ILSTS 056, ILSTS 028, ILSTS 073, ILSTS 026 and ILSTS 017) deviated significantly. Departure from HWE is mostly due to heterozygote deficiency which may result from one or more of the following reasons: (i) presence of null alleles (ii) small sample size and (iii) Wahlund effect i.e. presence of fewer heterozygotes in a population than predicted on account of population sub division. In farm animal species, the prevalence of sire lines selected for economic traits lead to increased consanguinity. However, this is less likely in Marathwada buffaloes as selection and use of extensive A.I. is very limited. Moreover, all the examined loci except ILSTS 089 and ILSTS 036 were observed to be neutral when subjected to Ewens-Watterson neutrality test suggesting that reduced heterozygosity in Marathwada buffaloes is unlikely to be the result of selection.

The fundamental causes for heterozygote deficiency and the consequent deviations from HWE is the possible consanguinity due to breeding among relatives as it was observed that few breeding males were available for breeding in most of the villages in the breeding tract. This is further supported by the data of 17th Livestock Census (2003) which shows that the proportion of available breedable males to breedable females as 1.39:100 in this region. Heterozygosity deficit in Marathwada buffalo population, thus presumably resulted from relatedness of samples as no pedigree record is available in the field.

Test for genetic bottleneck

The variation between allelic diversity and heterozygosity can be exploited to evaluate the mutation drift equilibrium of populations. Populations that have experienced a recent reduction of their effective population size exhibit a correlative reduction of the allele numbers and

heterozygosity (He) at polymorphic loci. But the allele numbers is reduced faster than the heterozygosity. Thus in a recently bottlenecked population, the observed heterozygosity is higher than the expected equilibrium heterozygosity (Heq) which is computed from the observed number of alleles, under the assumption of a constant size population (Luikart et al. 1998).

To determine the significant number of loci with heterozygosity excess in Marathwadi buffalo population, three tests were performed under three different mutation models viz. Infinite Allele Model (IAM), Stepwise Mutation Model (SMM) and Two Phase Model (TPM).

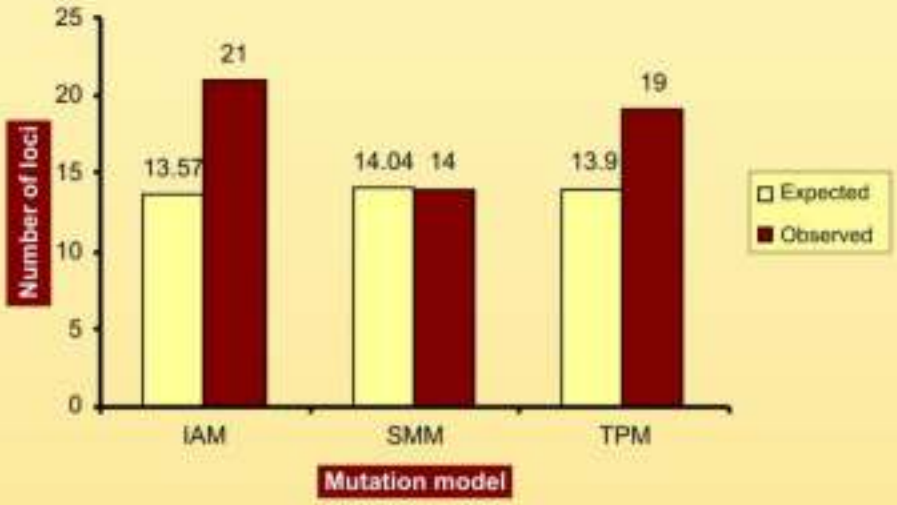

Figure 17. Expected and observed number of loci with heterozygosity excess under different models of mutation in Marathwadi buffaloes

Sign rank test showed significant heterozygosity excess under IAM and TPM, thereby rejecting the null hypothesis of mutation drift equilibrium. However, in case of SMM, though heterozygosity excess was found in 14 of the 24 loci studied, it was not significant (Figure 17). The results of the standardized difference test showed positive and significant T2 values under IAM and TPM, while it was negative and non-significant under SMM (Table 13, 14). Theoretically, it is not appropriate to assume that most of the loci evolved under either one model. Most microsatellite data sets better fit the compromised TPM (Di Rienzo et al. 1994) which consists of mostly one step mutations, but a small percentage (5-10%) of multi step changes.

Table 13. Observed and expected heterozygosity under different models of mutation in each of microsatellite loci analyzed

Locus	Observed He	Expected Heq		
		IAM	TPM	SMM
ILSTS058	0.754	0.641	0.702	0.747
CSSM066	0.663	0.488	0.553	0.62
ILSTS025	0.728	0.567	0.632	0.691
HEL013	0.792	0.742	0.788	0.821
ILSTS052	0.802	0.687	0.745	0.79
ILSTS029	0.477	0.362	0.436	0.487
ILSTS089	0.782	0.573	0.641	0.693
ILSTS061	0.59	0.571	0.639	0.694
CSRM060	0.712	0.648	0.704	0.75
ILSTS056	0.511	0.58	0.636	0.697
ILSTS028	0.419	0.49	0.547	0.609
ILSTS045	0.496	0.218	0.241	0.257
ILSTS030	0.519	0.495	0.552	0.617
ILSTS073	0.457	0.224	0.245	0.263
ILSTS026	0.646	0.488	0.557	0.619
ILSTS019	0.623	0.486	0.549	0.612
ILSTS095	0.803	0.579	0.64	0.698
ILSTS036	0.815	0.64	0.695	0.748
ILSTS017	0.514	0.376	0.431	0.487
ILSTS060	0.675	0.573	0.639	0.695
ILSTS031	0.693	0.487	0.546	0.608
ILSTS033	0.612	0.501	0.557	0.613
ILSTS068	0.754	0.603	0.662	0.708
BM1818	0.303	0.381	0.434	0.492

Table 14. Different tests for mutation drift equilibrium in Marathwada buffaloes

Test		IAM	SMM	TPM
Sign test	Expected no. of loci with He excess	13.57	14.04	13.90
	Observed no. of loci with He excess	21	14.00	19
	P-value for significant heterozygosity excess	0.001**	0.571	0.03*
Standardized differences test	T2-value	3.94	-0.031	2.32
	P-value	0.000**	0.488	0.010**
Wilcoxon sign rank test	P- value (one tail for He excess)	0.000**	0.363	0.004*

** Significant* ***Highly significant*

However, in case of farm animal species, it is better to assume the conservative stepwise mutation model to arrive at a conclusion for detection of bottleneck as microsatellites with 3 to 5 base repeats are thought to evolve predominantly under SMM (Shriver et al. 1993). This may be further evaluated by the qualitative test for mode shift, which utilizes the frequency distribution of different allele classes. The bottlenecks are expected to cause alleles at low frequency to become less abundant than alleles present in intermediate frequency leading to a mode shift. The qualitative graphical test (Cornuet and Luikart, et al. 1996) based on mode-shift distortion revealed the normal L-shaped curve as the alleles with lowest frequency (0.001 to 0.1) were found to be abundant (Figure 18). Thus it can be concluded although conservatively based on SMM and qualitative test for mode shift that Marathwada buffalo population has not deviated from mutation drift equilibrium.

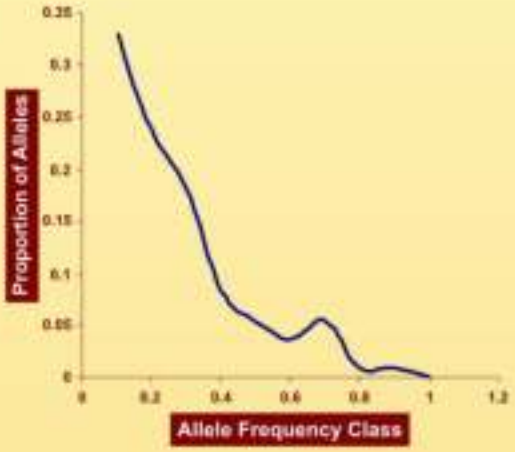

Figure 18. L-shaped mode shift graph showing lack of recent genetic bottleneck in Marathwada buffalo population

CONCLUSION

Marathwadi buffalo, the second numerically important buffalo breed in the state of Maharashtra and a prominent animal in the region has largely remained outside the purview of development. Lack of awareness regarding pure breeding resulted in the dilution of this important germplasm. Genetic diversity analysis revealed moderate genetic variability within this population. However, the heterozygote deficiency observed in the population as a result of unplanned breeding is a cause for concern. The importance of this breed as revealed by its survival and performance in low input system should motivate the breeders to follow better and organized breeding practices in the region. To begin with, a breed society needs to be established in the breeding tract so as to make genetic improvement and sustainable utilization of this precious germplasm.

REFERENCES

Acharya RM and Bhat PN (1984) Livestock and poultry genetic resources of India. IVRI, Research Bulletin No.1, Indian Veterinary Research Institute, Izatnagar, U.P. India.

Arora R, Lakhchaura, Prasad RB, Tantia MS and Vijh RK (2004) Genetic diversity analysis of two buffalo populations of northern India using microsatellite markers. J. Anim. Breed. Genet., 121 : 111-118.

Botstein D, White RL, Skolnick M and Davis RW (1980). Construction of a genetic linkage map in man using restriction fragment length polymorphisms. Am. J. Hum. Genet. 32, 314–331.

Cockrill WR (1974) The husbandry and health of domestic buffalo. Food and Agriculture Organization, Rome.

Cornuet JM and Luikart G (1996) Description and power analysis of two tests for detecting recent population bottlenecks from allele frequency data. Genetics 144, 2001–2014.

Di Rienzo A, Peterson AC, Garca JC, Valdes AM and Slatkin M (1994) Mutational processes of simple sequence repeats in human populations. Proc. Natl. Acad. Sci., USA, 91: 3168-3170.

George M, Balaine DS, Vij PK and Kumar S (1988) Conservation and management of buffalo genetic resources of India (ed. R nagarcenkar). Buffalo Production and Health, pp. 31-37, ICAR, New Delhi.

Gujar BV (2007). Final report of research scheme on Characterization and Evaluation of Marathwadi buffalo (1998-2002), ICAR Adhoc Project, Indian Council of Agricultural Research, New Delhi.

Luikart G, Allendrf FW, Cornuet JM and Sherwin WB (1998) Distortion of allele frequency distributions provides a test for recent population bottlenecks. J. Hered. 89 (3) : 238-247.

Nei M (1973) Analysis of gene diversity in subdivided populations. Proc. Natl. Acad. Sci. USA, 70 : 3321-3323.

Kathiravan, P., Mishra, B.P., Kataria, R.S., Sadana, D.K., 2009. Evaluation of genetic architecture and mutation drift equilibrium of Marathwada buffalo population in Central India. Livest. Sci. 121, 288-293.

Kumar S, Gupta J, Niraj K, Dikshit K, Navani N, Jain P and Nagarajan M (2006) Genetic variation and relationships among eight Indian riverine buffalo breeds. Molecular Ecology, 15 : 593-600.

Shriver MD, Lin L, Chakraborty R and Boerwinkle E (1993) VNTR allele frequencies distributions under the step-wise mutation model: a computer simulations approach. Genetics, 134 : 983-993.

Soysal MI, Ozkan E, Kok s, Tuna YT and Gurcan EK (2005) Genetic characterization of indigenous Anatolian Water buffalo breed using microsatellite DNA markers. J. Tekirdag Agricultural Faculty, 2 (3) : 240-244.

Breed Descriptor of Marathwadi Buffalo
Accession No. INDIA_BUFFALO_1100_MARATHWADI_01009

1. **General Description**

Name of the breed	:	Marathwadi
Synonyms	:	Ellichpuri, Dharwadi
Back ground for such a name	:	The buffalo derives its name from the place of its origin i.e Marathwada in Maharashtra
Species	:	Bubalus-bubalus (Riverine type)
Since when the breed is known	:	The peculiar buffalo of the region is known as 'Sathapuri' in local markets around Parbhani. The term Marathwadi first appeared in published literature in 1965.

2. **Native Tract and distribution**

a) Latitude and latitude	:	Between 17°35' Nand 20° 40° N latitude and between 70° 40' E and 78° 15' E longitude.
b) Area of distribution	:	Parts of the Marathwada revenue division of Maharashtra state especially Parbhani, Nanded, Jalna, Beed and Latur districts.

3. **a. Communities Responsible for developing the breed** : Local farmers
   b. Description of community : Small and marginal farmers

4. **Native environment** : Soils - Retentive black cotton soils classified as 'vertisols' dominate central part of region surrounded by Balaghat ranges with light soils.

Temperature	:	Minimum range:12°-18°C (Nov-Jan months) Maximum range: 40°-45°C (Apr-Jun months)
Rainfall	:	500 - 110 mm

5. **Feed and fodder resources**

a. Fodder sources (dry and green) : Jowar (Sorghum - vulgare), Bajra (Pennisutum typhodium), Maize (Zea¬mays), Cowpea (Vigna-scinesis), Oat (Avena-sativa), Berseem (Trifolium alexandrinum), Lucerne (Medica-sativa), Sugarcane tops, Crop residues of Cajanas¬cajan (Tur), Arachis hypogea (Gr. nut), Sunflower, Pawta.

	b. Fodder Grasses	:	Anjan (Cenchrus-sp), Marvel-B (Dicanthium-anulatum), Pawana (Sehima¬nervosum), Dashrath (Desmanthus¬virgatus), Hariyali (Cynodon dactylon), Kalikusli (Heteropogon-contratus), Blue¬panic. Dongri Gawat (Chrysopogon¬fulvus), Kunda (Teachninusum pilosum).
	c. Fodder Trees	:	Anjan (Hardwickia-binata), Subabool (Leucacena lencocephala), Shewri (Sesbania-egyptica).
	d. Crop residues	:	Jowar bhusa, straw of wheat, paddy, soybean and safflower, ground nut, husk, mung husk, tur guli, sugarcane tops, mulbery leaves and stalks
	e. Crop weeds	:	Legumes- Shevera (Alysicarpus rugosus) & Hedge Lucerne.
6.	**Housing**	:	The buffaloes are provided housing mostly during night hours, which is often open and kutcha (cement not used). It lacks proper flooring and is half walled.
7.	**Mating**	:	Uncontrolled natural service
8.	**Physical Characteristics**		
	Colour		
	a. Coat	:	Jet black (2.1 %), Black (97.7%) Grey (0.2%)
	b. Muzzle	:	Black (95.2%) Jet Black (2.2%) Grey (0.8%)
	c. Eyelids	:	Black (97%) Jet Black (5.1%) Grey (4.3%) white (0.5%)
	d. Tail Switch	:	Black (67%) Jet Black (5.1%) Grey (1.6%) White (26.5%)
	e. Hooves	:	Black (96.2%) Jet Balck (0.8%) Grey (2.8%) White (0.2%)
	Horns		
	a. Colour	:	Black ((6.7%) Brown (3.3%)
	b. Size	:	43 + 7.2 cm
	c. Shape	:	Curved (94.77%) Straight (5.23%)
	e. Orientation	:	Not extended beyond hump, placed close at base
	Ears		
	a. Length	:	25.68 + 3.56 cm
	b. Orientation	:	Drooping (96.1%) Horizontal (3.9%)

Head		
a. Face	:	Lean
b. Nasal bridge	:	Straight
c. White patch on forehead	:	Present in 18.5% animals
Tail	:	Black, long, reaching up to hock joint
Temperament	:	Docile
Udder Shape		
a. Round	:	62.9%
b. Trough	:	17.0%
c. Bowl	:	12.8 %
d. Pendulous	:	(8.1%)
Fore udder		
a. Medium	:	69.2%
b. Small	:	20.8%
c. Large	:	10.0 %
Rear Udder		
a. Medium	:	70.8%
b. Small	:	19.5%
c. Large	:	9.8 %
Placement of teats		
a. Square	:	59.3 %,
b. Wide at front	:	35.8 %
c. Wide at back	:	5.0 %
Teat shape		
a. Cylindrical	:	45.6%
b. Funnel	:	41.3%
c. Pear	:	13.2%
Teat tip		
a. Pointed	:	32.4%
b. Rounded	:	61.9%
c. Flat	:	5.7%
9. **Utility of the breed**	:	Milk

10. Performance

Body measurements (cm)

Trait	Female	Male
Chest girth (cm)	181.64	187.12
Body length (cm)	128.52	149.00
Height at withers (cm)	124.35	133.00
Height at pin bones (cm)	116.09	128.00

Milk production and quality

Milk yield	:	3.52 lit. per day
Lactation length	:	318 days
Lactation yield	:	1118 lit.
Fat	:	6.25 %
SNF	:	8.50%
Specific gravity	:	1.031

Reproduction (females)

a. Age at first oestrus	:	40.67 months
b. Oestrus duration	:	25.20 hours
c. Oestrus cycle period	:	21.07 days
d. Age at first conception	:	42.26 months
e. Age at first calving	:	52.30 months
f. Service period	:	187.50 days
g. Gestation length	:	309.67 days
h. Calving interval	:	16.70 months

Published by: Director, NBAGR

For enquiries, please contact
Director, National Bureau of Animal Genetic Resources
(Indian Council of Agricultural Research)
P.O. Box No. 129, GT Road Bypass, Near Vasant Vihar, Karnal 132 001 (Haryana)
Tel: 0184-2267918 Fax: 0184-2267654 Email: director@nbagr.ernet.in