Buffalo Genetic Resources of India

BHADAWARI

National Bureau of Animal Genetic Resources
(Indian Council of Agricultural Research)
P.O. Box No. 129, Karnal (Haryana)

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Compiled and Edited by :

RS Kataria, BP Mishra and DK Sadana
SWG (BUFFALO)

NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES
P.B. NO. 129, KARNAL – 132 001 (HARYANA)

PREFACE

India is habitat of the best riverine breeds of buffalo, playing important role in livestock production in terms of milk, meat and draft power. The buffalo milk husbandry brings greater economic returns to the farmer, therefore during last few decades continuous growth in buffalo population has been observed in our country. The buffaloes are contributing about 53% of total milk production of the country and because of more liking for buffalo milk in Indian rural as well as urban population, they are considered animal of choice for milk production. Buffaloes as a source of meat for export, are also gaining importance now.

Among the world's best buffalo genetic resources available in India, 'Bhadawari' is better known for its milk fat percentage, recorded as high as 13%. Bhadawari buffalo needs immediate attention of policy makers as there is steep decline in Bhadawari population in its native tract in Uttar Pradesh and Madhya Pradesh. Indiscriminate breeding using Murrah semen in its home tract is diluting Bhadawari germ plasm to great extent. Uttar Pradesh Government has undertaken important steps in Bhadawari breed conservation and improvement in recent past. There is an urgent need to initiate work on genetic characterization of Bhadawari, which has been done to a limited extent so far, in order to exploit its genetic potential for peculiar milk qualities.

The bulletin is compilation of information on production and reproduction performance of Bhadawari along with Breed Descriptor developed for physical and morphological characterization and limited genetic characterization work carried out so far. Authors wish to thank Director, NBAGR for taking initiatives in compilation and update of this information on Bhadawari. Authors feel grateful to I/C Photography Unit, NBAGR and Mr. Moti Ram, for providing photographs. Data inputs provided by Dr. R.K. Pundir and Dr. M.S. Tantia, Senior Scientists, NBAGR and Dr. S.S. Kundu, Principal Scientist and Head, Plant Animal Relationship Division, IGFRI, Jhansi, are also gratefully acknowledged. 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

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Introduction

India is the major mega-biodiversity centres privileged in having a rich diversity of buffalo breeds, spread throughout the country. Each buffalo breed / population has its own special characters / features which make it efficient in its natural habitat. Various attempts have been made to document all these breeds and populations to know their distribution, population size, unique features and performance. Of the 10 recognized buffalo breeds viz Murrah, Nili Ravi, Bhadawari, Mehsana, Surti, Jaffarabadi, Pandharpuri, Marathwara, Nagpuri and Toda, Bhadawari is one important breed that is well known for its high milk fat percentage. Although no distinct information is available about the origin and distribution of Bhadawari breed, but it is a pride animal of Bhaduria clan of erstwhile Bhadawar state of pre–independence India. The term Bhadawari was probably coined from the word Bhadawar, which is the home tract of this breed.

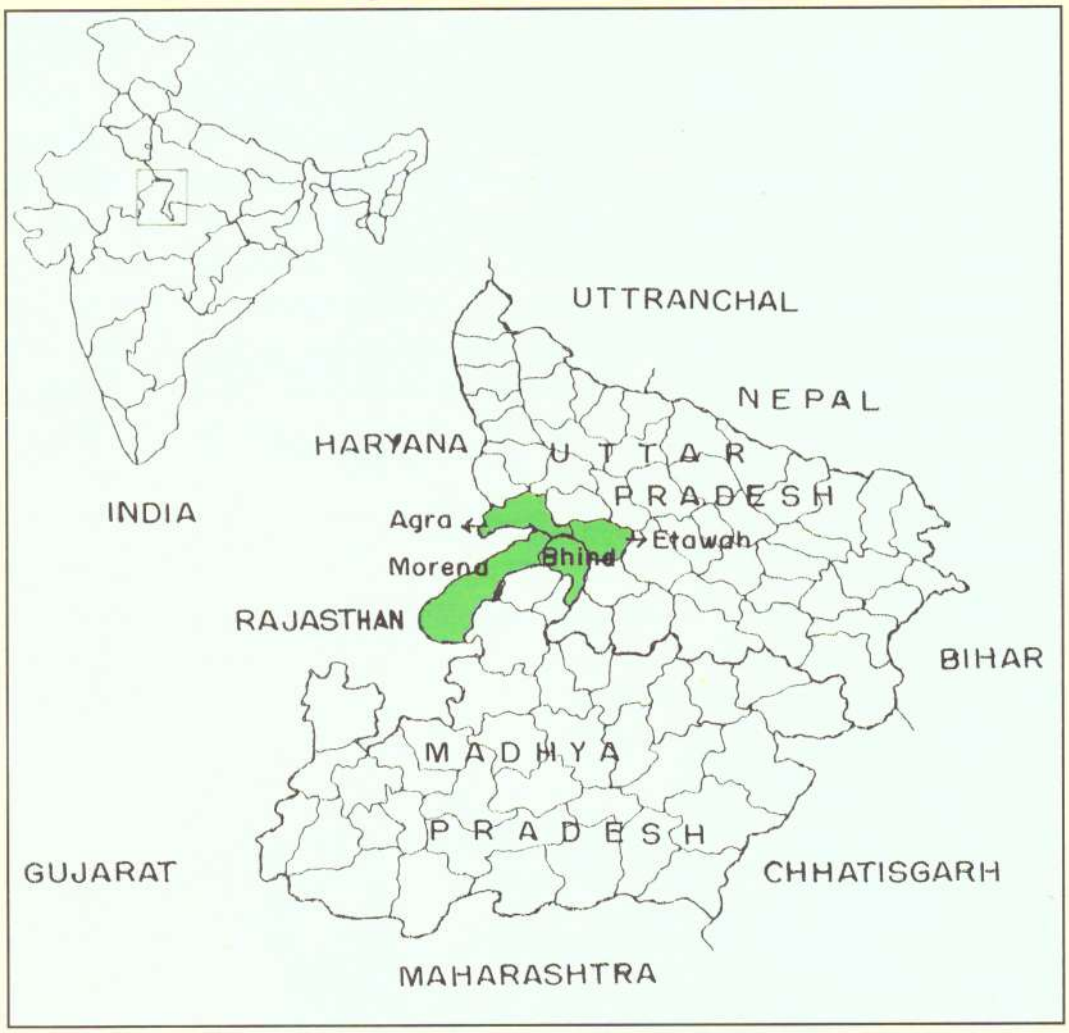
Geographic Distribution

Bhadawari buffaloes are mostly spreadout in the ravines of Yamuna, Chambal and Utangan rivers in Uttar Pradesh and Madhya Pradesh. On the basis of the population distribution, the breeding tract of Bhadawari buffaloes may be divided into a major and a minor tract. The major breeding tract is the Etawah district of Uttar Pradesh and the minor tract is the Agra district of Uttar Pradesh and adjoining Bhind and Morena districts of Madhya Pradesh. These buffaloes are found in Bah tehsil of Agra, Chakarnagar and Barhpura blocks of Etawah, Ambah and Porsa tehsils of Morena and Mahangaon tehsil of Bhind districts.

Population

As per 1977 census, total Bhadawari population in India, was around 160,000 with 70,000 breedable females. There was alarming decline in the population from 1977 to 1991, particularly in Uttar Pradesh as 1991 survey conducted by State Animal Husbandry Department reported only 29000 animals (just 0.54% of total buffalo population of the state), whereas buffalo population of India showed overall increase by 24.39% and that of Uttar Pradesh by 30.9%. Two surveys conducted in 1993 and 1995 in 97 villages of breeding tract in Uttar Pradesh and Madhya Pradesh, revealed seven villages not having any Bhadawari

Breeding tract of Bhadawari buffalo



buffalo. Total population in 34 villages of Etawah district was 1195, in 46 villages of Agra district it was 696 whereas in 10 villages of Morena district of M.P. not a single Bhadawari buffalo could be traced. As per Pundir *et al.* (1997) total estimated Bhadawari buffaloes in its breeding tract was 37, 706.

During recent survey under NATP- Mission Mode project (2004) in the 97 villages of the 2 blocks of Etawah district, only 983 animals were actually available, while 390 animals

were found in 144 villages of 3 blocks of Agra district. In the survey conducted, it was observed that 6 villages of Etawah district and 4 villages of Agra district did not have any Bhadawari buffaloes. The Bhadawari population in most of the villages ranged from 1 to 3 animals per household. Maximum number of buffaloes (45) were found in Rajpur village in Etawah district, whereas, maximum number of 17 buffaloes in Agra district were found in Kachora Ghat village. A recent report from IGFRI, Jhansi also indicates total Bhadawari population in the country between 10,000 and 15,000 animals with an average of 2-3 animals per village in the breeding tract.

Breed Descriptor of Bhadawari*

I General Description

1. **Name of the breed :** Bhadawari
2. **Background for such name :** Bhadawar Estate
3. **Since when the breed is known :** Since long time
4. **Communities responsible for developing the breed :** Hindu, Muslim, OBC (Yadav), SC (Nut)
5. **Native environment**
   - a. Soil description : Alluvial soil
   - b. Average temperature range : 38° C
   - c. Mean minimum temperature : 2.5° C
   - d. Mean maximum temperature : 48.8° C
   - e. Mean relative humidity : Maximum – 80%, Minimum – 32%
   - f. Annual rainfall : Ranged from 575 to 750 mm
   - g. Peak rain : 750 mm
   - h. Duration of rain in months : July to September
6. **Feed and fodder**
   - a. Dry feeds : Wheat straw (Bhoosa), Cadvi of Bajra, Maize and Jawar
   - b. Green fodder : Barseem, Lucerne, Bajra, Maize, Jawar, Taramine
7. **Housing**
   - a. During night only : 88.65 %
   - b. Day and night : 11.35 %
   - c. Housed in Kuchha : 80.20 %
   - d. Housed in Pacca : 19.80 %
   - e. Open houses : 74.10 %
   - f. Closed type houses : 25.90 %
8. **Mating method**
   - Natural service : 92.40 %
   - Artificial insemination : 4.10 %
   - Both A. I. And N.S. : 3.50 %

II Physical Characteristics

1. **Colour**
   - Skin : Copper – 84.80 %, Grayish Black – 8.60 %, Black – 6.60 %
   - Muzzle : Black – 79.20 %, Brown – 18.80 %, White – 2.00 %
   - Eyelid : Black – 48.70 %, Brown – 31.50 %, Copper – 19.80 %
   - Tail length : Above hock – 12.30 %, At hock – 41.00%, Below hock – 46.70 %
   - Hooves : Black – 56.30 %, Gray – 43.70 %
2. **Horns**
   - Colour : Black – 99.50 %, Brown – 0.50 %
   - Size : 21.95 ± 1.05 cm

Shape	:	Straight – 50.30 % Curved – 49.70 %
Orientation	:	Lateral, downward
Horn tips	:	Lateral pointing – 39.00 % Inward pointing – 27.90 % Upward pointing – 19.50 % Downward pointing – 12.60 % Forward pointing – 0.50 % Backward pointing – 0.50 %

3. **Ears**

Length	:	21.16 ± 0.38 cm
Orientation	:	Horizontal – 56.90 % Dropping – 43.10 %

4. **Head**

Length	:	35.94 ± 0.55 cm
Poll	:	Prominent – 86.70 % Not prominent – 13.30 %
Peculiar Character	:	White marking Head/ Forehead

5. **Body**

Hump	:	Large – 5.10 % Medium – 16.80 % Small – 78.10 %
Dewlap	:	Large – 4.60 % Medium – 18.30 % Small – 77.10 %
Naval flap	:	Large – 3.60 % Medium – 3.10 % Small – 93.30 %

6. **BasicTemperament**

Docile	:	92.60 %
Moderate	:	4.20 %
Tractable / wild	:	3.20 %

7. **Udder**

Shape	:	Bowl – 74.00 % Round – 20.10 % Trough – 3.30 % Pendulous – 2.60 %
Fore udder size	:	Large – 18.70 % Medium – 41.30 % Small 40.00 %
Rear udder size	:	Large – 13.10 % Medium – 13.00 % Small 73.90 %
Teat shape	:	Cylindrical – 80.50 % Funnel – 14.90 % Pear – 4.60 %
Teat tip	:	Pointed – 51.30 % Round – 41.60 % Flat – 7.10 %
Milk vein	:	Large – 16.90 % Medium – 28.00 % Small – 55.10 %

III Performance

1. **Body Measurements in Adult Females**

Body length	:	138.78 ± 7.57 cm
Height at wither	:	126.33 ± 1.88 cm
Chest girth	:	185.02 ± 3.50 cm
Paunch girth	:	199.48 ± 3.69 cm

2. **Dairy Performance (Average)**

Daily milk yield	:	3.90 kg
Lactation length	:	271 days
Fat	:	7.0 %
SNF	:	9.20 %

3. **Reproduction**

Age at first ostrus	:	43.37 ± 0.27 months
Age of first mating	:	44.90 ± 0.40 months
Age at first calving	:	54.96 ± 0.47 months
Service period	:	153.25 ± 2.11 days

Number of services

Per conception	:	1.75 ± 0.04
Calving interval	:	462.38 ± 4.60 days

Reproductive disorders : 22.70 %
(Dystocia, placental – retention etc.)

** Source: NATP (Mission Mode) on "Animal Genetic Resources Biodiversity."*

Bhadawari buffalo

Bhadawari calf

Bhadawari bull

Bhadawari buffalo herd

Production Performance

According to Pundir *et al.* (1997), first lactation total milk yield in Bhadawari was 780.0±25.4 Kg, which is significantly influenced by lactation length. Milk yield was highest in the first period and started declining in subsequent periods. First lactation milk yield of 300 days based on 215 observations was 711± 28.2 Kg with period of calving having significant influence. Pooled total lactation milk yield has been observed to be 781.31 ± 29.4 Kg for second lactation. Maximum milk yield was in the second lactation and then it remained static up to parity 4 and then gradually declined up to parity 7. As given in Table 1 a wide variation has been recorded in the milk yield of farm and village animals. Pooled 300 days lactation yield for Bhadawari buffalo has been observed as 812 ± 23.8 Kg, which is not influenced by the order of parity, period and season of calving. Report from Bhadawari Farm at IGFRI, Jhansi indicated average lactation yield of 1067.95 Kg in a total herd strength of 78 animals.

Milk Composition

Pundir *et al.* (1996) recorded average fat percentage as 7.14± 0.44 and SNF as 9.57±0.19 in farm and village animals. (Table 1) Bhadawari buffaloes are known for producing milk with high fat percentage. Some animals have been recorded to have produced milk with as high as 13% fat. Decrease in fat percentage in the population is attributed to dilution of Bhadawari germ-plasm because of grading up by Murrah buffalo to increase the milk yield. Total solids percentage in Bhadawari buffalo milk is reported to be 16.71%. Bhadawari Farm at IGFRI, Jhansi has recently reported average fat percentage of 7.52, total solids 17.98% and solids not fat 10.05%.

Lactation Length

Lactation length in Bhadawari is reported to be 271.8 ± 3.98 days varying from 139.4 ± 37.29 days to 351.2 ± 12.35 days for all lactations. Parity and period of calving significantly influence the lactation length, whereas farm and season of calving has no influence on this trait. Average lactation length at Bhadawari Farm of IGFRI, Jhansi is reported to be 296 days.

Milk Yield

Milk yield per day in Bhadawari was recorded to be 2.76 Kg ranging from 2.24 to 3.95 Kg for all lactations. Yield was higher for animals calving in first period and there was gradual decline up to period 4 (Table1). Some reports also indicated higher estimate of 3.72 Kg. The influence of parity and season of calving on milk yield per day of lactation length was non-significant. At Bhadawari Farm of IGFRI, Jhansi overall wet average of 3.44 kg, herd average of 1.35 Kg and a peak yield of 6.6 Kg has been recorded.

Average dry period for Bhadawari buffalo ranges from 143.4 for fifth lactation to 296.6 days for first lactation. Significant effect of parity and calving period has been reported for dry period.

Table 1. Milk yield (Kg) and fat percentage in Bhadawari (Singh *et al.*, 1994)

S. No.	Lactation Order	Daily Milk Yield			Peak Milk Yield		
		Farm Animals	Village Animals	Pooled	Farm Animals	Village Animals	Pooled
1.	I to II	3.05±0.20	2.60±0.24	2.84±0.16	4.63±0.27	4.22±0.20	4.40±0.20
2.	III to V	2.68±0.15	2.76±0.15	2.73±0.12	4.22±0.19	4.90±0.18	4.62±0.13
3.	VI to onwards	–	2.17±0.15	–	–	3.41±0.14	–
4.	Overall	2.88±0.29	2.57±0.32	2.70±0.37	4.44±0.33	4.34±0.36	4.37±0.49

S. No.	Lactation Order	Fat Percentage		
		Farm Animals	Village Animals	Pooled
1.	I to II	8.79±0.30	7.99±0.18	8.42±0.18
2.	III to V	8.12±0.34	9.05±0.27	8.70±0.21
3.	VI to onwards	–	8.73±0.33	–
4.	Overall	8.53±0.46	8.63±0.45	8.58±0.63

Reproduction Performance

Age at first fertile service in Bhadawari has been recorded to be 38.64± 0.48 months. Bhadawari are reported to be seasonal breeders with maximum number of animals breeding between September and December with highest percentage (26%) in October and lowest in May (0.6%). The age at first conception based on 25 observations was 48.1 months (Singh

and Nivsarkar, 1997). Age at first calving is reported to be 48.62± 0.58 months (range: 44.4± 0.67 to 51.39± 1.55 months). Age at first calving in Bhadawari buffaloes at Etawah farm is recorded to be 58.3 months. Year of calving had significant influence on age at first calving while season of conception has no significant influence, which is attributed to differences in the environment and managemental conditions during their growth period. There is no influence of farm, season and period of birth on age at first calving.

Average service period of Bhadawari buffaloes is recorded to be 213.3± 21.7 days varying from 137 to 317 days for all lactations and is significantly influenced by parity, order and period of calving. Calving interval is recorded to be 478.7± 11.55 days with a range from 388 to 633 days. Farm, parity, season and period of calving do not have significant influence on calving interval. Animals calving during rainy season have shortest calving interval. At IGFRI, Jhansi Farm, average service period, dry period and calving interval have been recorded to be 137.9, 220.25 and 444.5 days respectively.

Average gestation length of Bhadawari buffaloes is reported to be 306.9± 1.75 days (range : 299.2± 2.02 to 311.5± 2.10 days). Parity had non-significant effect on gestation period. Breeding efficiency of Bhadawari buffaloes is recorded to be 83.1± 2.6% with significant effect of dry period, parity and year & month of calving.

Cytogenetic Studies

Karyotyping studies have been carried out to elucidate the chromosomal profile of Bhadawari from Pokeweed mitogen stimulated lymphocytes (Pundir *et al.*, 1997). A diploid count of 50 chromosomes with typical mammalian type sex chromosomes were observed, classifying autosomes into two groups on the basis of the position of the centromere. Ten chromosomes were found to be metacentric/submetacentric in their morphology and rest of the thirty eight autosomes were acrocentric in nature. The X chromosome has been reported to contribute about 5% to the genome, the largest of submetacentric chromosomes contributing 6.89% and the largest acrocentric 4.57% of the genome.

Genetic Characterization

A combined study carried out on microsatellite characterization of Bhadawari and Tarai buffaloes, using a set of 10 autosomal bovine microsatellite markers (CSSM33, CSSM66, ETH3,

HAUT24, ILSTS005, ILSTS011, ILSTS019, ILSTS034, ILSTS038, ILSTS052) by PCR and PAGE, has revealed these markers to be highly polymorphic (Arora *et al.*, 2003; 2004). Number of alleles in Bhadawari for these loci ranged from 2 to 6 with an average of 3.5. Polymorphic Information Content (PIC) value for Bhadawari varied between 0.1387 and 0.6877. The genetic distances estimated between individuals using allele-sharing method have been utilized to construct topology / tree, which indicated Tarai and Bhadawari buffalo populations to be less differentiated. In another report on Tarai and Bhadawari buffalo breeds using 22 microsatellite markers, three private alleles were reported at each of ILSTS019, ILSTS052 and ILSTS059 loci in Bhadawari.

Table 2. Heterozygosity values in Bhadawari (Arora *et al.*, 2003)

Locus	No. of Observations	Unbiased Heterozygosity	Heterozygosity (Direct Count)
CSSM33	40	0.6769	0.8500
CSSM66	39	0.5731	0.6154
ETH3	31	0.4209	0.5161
HAUT24	36	0.5782	0.3333
ILSTS005	39	0.4945	0.5385
ILSTS011	39	0.6051	0.8462
ILSTS019	38	0.5544	1.0000
ILSTS034	37	0.5983	0.9730
ILSTS038	40	0.1405	0.1500
ILSTS052	39	0.6966	0.6410
Average		**0.5339**	**0.6463**

Conservation of Bhadawari

The steep decline in Bhadawari population in its native tract warrants immediate intervention of government and other agencies. Some programmes have been initiated at central and state government levels for the conservation and improvement of this valuable germplasm. First necessary step is stoppage of use of Murrah buffalo semen in the native tract of Bhadawari. At Etawah farm of Uttar Pradesh, Bhadawari animals are being

maintained to produce bull calves for breeding. Besides, under NATP (Mission Mode) programme of NBAGR, Karnal (ICAR), at Mathura Veterinary College, about 20 bulls have been procured for *ex situ* conservation and for breeding purpose. Also, Animal Husbandry Department of Uttar Pradesh has procured breeding bulls at semen collection centre, Lucknow. Particularly in Etawah district, AI only by Bhadawari semen is being practiced in buffaloes.

Under the National Gene Bank programme of National Bureau Animal Genetic Resources (NBAGR), Karnal, semen of Bhadawari bulls has been procured and stored for posterity. In addition, somatic cell lines (skin fibroblast) have also been developed and preserved in the Somatic Cell Bank of NBAGR, Karnal.

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For enquiries, please contact :

DIRECTOR, NATIONAL BUREAU OF ANIMAL GENETIC RESORCES

(Indian Council of Agricultural Research)

P.O. Box. No. 129, G.T. Road By-Pass, Near Vasant Vihar, KARNAL - 132001 (Haryana)

Tel. : 0184-2267918 Fax : 0184-2267654 E-mail : director@nbagr.ernet.in