



## Research Article

# DONKEY GENETIC RESOURCES OF INDIA

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**Abstract:** Donkeys play a crucial role in poor households in developing countries like India though, they are largely invisible in development policy and plans and they often fail to find their place in agricultural and food security plans. They are neither on the livestock radar in agricultural or food security discussions nor do they feature in transport policy discussions. Donkey occupy a place in government statistics but their economic value is not articulated correctly. Unlike bovines, they are never a part of export or trade debate. Three registered breeds of Donkey in India are; Kachchhi, Halari and Spiti and there are few more donkey populations that have been studied for their genetic variability. This review focuses on status of donkey as a livestock resource in India with special reference to Marathwada.

**Keywords:** Donkey, Genetic diversity, Phylogenetic analysis, Bottleneck analysis

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## Introduction

Donkeys are referred to as 'beast of burden'. They are a good source of pack animals in marsh and mud occupied places. Minimum maintenance cost is required for rearing of these animals and they tend to be very faithful to their owner. They demonstrate very good draught power, they are immune to many diseases and also possesses high stress bearing capabilities [1-3]. The total Donkey population of India is 1.12 lakhs of these, 18 thousand donkeys belong to state of Maharashtra and the state ranks second followed by Rajasthan with respect to number of Donkeys. (20<sup>th</sup> Livestock Census). The population trend and ranking of various states of India with respect to donkey population have kept fluctuating since last few censuses and there have been a marked fall in number of Donkeys in all states in 20<sup>th</sup> Livestock census as compared to the 19<sup>th</sup> census. In India decreased demand, indiscriminate and un-systematic breeding, poor health and managerial practices etc are believed to be the reasons for this constant reduction in population [4]. Brook India, (NGO working for betterment of Equine population in East and African countries) appended theft and illegal slaughter too as the reason for decline in population along with reduced utility and grazing land. Donkeys around the world are slaughtered for gelatine found in their skin called 'ejiao', which is used in traditional Chinese medicine.

An estimated 100 million working equines worldwide are transporting goods to market, working in the construction, agriculture, and waste management industries, and operating as taxis [5]. In Marathwada, the donkeys are traditionally reared by washer-man community and pot makers. These animals are also used in brick kilns. The major utility of these animals is for carrying sand from the river bed and transportation of silted clay soil for preparation of bricks. They prove beneficial for transportation of goods/material through a narrow lane/road where automobiles cannot reach. They also prove to be useful in swampy and water-logged areas or in rainy season for transfer of goods.

Donkeys also find their place in the cultural heritage of Marathwada. On occasion of holi, in Wida village of Kaij tehsil of Beed district, the 'newest son-in-law' in the village is offered a donkey ride. It is said that the tradition has been followed for over more than 90 years. (India times). The sale and purchase of Donkeys are done at Donkey markets and the major markets are located at Malegaon (Nanded), Jalna, Jejuri (Satara) and Madhi (Ahmednagar).

The markets are held once in a year. Hot spot for trading of Donkeys in Marathwada is Malegaon.

## Donkey breeds of India

There are three registered breeds of Donkey in India viz., Kachchhi, Halari and Spiti. Kachchhi donkeys are found in Kachchh District of Gujarat. Coat colour of these animals is mainly grey (dorsal surface grey & ventral surface white) followed by white, brown and black. They have a convex forehead. Nasal bone is straight. The animals are docile in temperament. They are used in agriculture for inter cultivation and weed removal. During pastoralist migration, they are utilized for transportation of donkey carts, and as pack animal. Can carry approx. 80-100 Kg on back and can pull 200-300 Kg on cart. Halari animals are native of Saurashtra and Jamnagar region of Gujarat. They are white in colour. Muzzle and hooves are black. Forehead is convex. These donkeys are strong built and they have a large size. The average height at wither is 108cm in males and 107cm in females. These donkeys are used as pack animals during pastoralist migration and for transportation as donkey cart.

The Spiti donkeys belong to the Spiti subdivision of Lahaul-Spiti and Phu of Kinnaur district of Himachal Pradesh. They are small sized animals with the average height at wither ranging from 80 to 90cm. They are brown, dark brown and black in colour. The face and whole body is covered with long hairs. Head is comparatively broader and shorter. Spiti donkeys can carry upto 100kg of load in high altitude mountainous area where atmosphere is having lesser oxygen.

## Lesser known Donkey population of India

Donkey population of Rajasthan has been characterized for their phenotypic characters. These donkeys provide draught power in pastoral migration and other draught operations. They are very hardy and surefooted. The animals demonstrate zebra marking on legs and dorsal stripes on back. Coat colour varies from light and dark gray accompanied by shoulder crosses. Bellies and inner legs are white in color. Mean height at withers for the animals was found to range from 88 to 109cm [4]. The brown type donkey of Kurnool and Anathapur districts, of Andhra Pradesh has also been evaluated for within breed genetic diversity [6].

They are also known as donkeys of Rayalseema region. Majority of the donkeys in Andhra Pradesh are predominantly of the light brown to brown coat colour with lighter bellies. The mean heights at wither of these type of animals are  $94.57 \pm 5.24$  and  $89.82 \pm 3.36$  cm in adult males and females, respectively. They can lift weight up to 100 kg. They are utilized for transporting cloths, sand and bricks and also for transportation of bamboo from the jungle [7].

The donkeys of Ladakh region of Jammu and Kashmir have been characterized for microsatellite analysis [8]. The population found here are well adapted to cold, arid and hypoxic environment of the region. They have light brown to dark brown coat colour with lighter bellies. Height at withers for their donkeys is  $94.27 \pm 3.75$  and  $93.85 \pm 3.8$  cm in males and females, respectively (<https://nbagr.icar.gov.in>).

Lesser known population of donkeys for which the conservation work has initiated is donkey of Braj region of Uttar Pradesh. The population was characterized by undertaking survey in Mathura and Agra district of Uttar Pradesh. These donkeys have well-built and deep bodies. Back is straight. Nasal bone is slightly concave at the mid-point of the face and then slightly raised near the muzzle. The height at withers, body length, chest girth and estimated body weight of these donkeys are  $102.33 \pm 4.14$  cm,  $99.64 \pm 4.54$  cm,  $107.58 \pm 6.95$  cm and  $98.41 \pm 16.02$  kg. These donkeys are mainly used as pack animals for transportation of construction material like sand and bricks [1].

An attempt to characterize donkey population of south western Bihar was also made [9]. The Donkey population of Bihar ranged from small (75 cm to 90 cm) to medium (91 to 105 cm) height. Donkeys exhibited well developed body while neck and mane were short. There were zebra marking on legs and stripe on back. Back of donkeys was straight and sloppy on sides. Face was observed to be convex with large ears. The body coat colour was dark grey to light grey. These donkeys are mainly utilized in brick-kilns around Patna.

Another population of donkey in Maharashtra that needs recognition is Kaikadi donkey from Vidarbha region of Maharashtra [10]. These pack animals of Vidarbha primarily grey to brown or dark brown in colour. Though a thin coat of hair is present all over the body, tuft of hairs is present around mane, ears, and face. Adult donkey body weight ranges from 28-35 kgs while height at wither of these donkeys was 88.11 cm. They are reported to have a concave forehead and chest girth is around 93.22 cm [11]. They have primarily being reported to be used for transportation of goods and as pack animals at brick kilns.

Donkey population of Marathwada also has a greater potential to be identified as a breed. The typical features of these donkeys include grey to brown coat colour. Some are white in colour. A dorsal line on the back starting from the head up to tail is prominent in grey or brown coloured animals. Other features include white ring around eye and muzzle. The area on the belly and between fore legs and hind legs is white in colour. Ears shows a marked dark outline. The area around the lower jaw is also white in colour. An adult animal can lift upto 40-80 kgs of weight effortlessly hence they are also used for shipping of bricks, agricultural products and by-products, including grains and straw, roughes.

### Genetic study of Donkey population in India

Molecular markers, primarily microsatellite markers are proven tools used to determine genetic diversity and relationship within and between animals. Many workers efficiently used microsatellite markers for revealing genetic variation among various donkey breeds. Bhel, *et al.*, (2017b) [6], Bhel, *et al.*, (2019) [8], Behl, *et al.*, (2017a) [12], Sharma, *et al.*, (2017) [13], Bhel, *et al.*, (2021) [14] of which the work carried out in India is reviewed in this paper. Twelve microsatellite *loci* were used to study genetic diversity and bottlenecks in Spiti donkey of Himachal Pradesh. The PCR product size for the *loci* ranged from 78–87 bp at locus VHL20 to 253–271 bp at locus COR18. The observed number of alleles ranged from 4 (VHL20, HTG6) to 10 (HTG7), with a mean ( $\pm$ SD) of  $6.33 \pm 1.72$  alleles per locus. The effective number of alleles ranged from 2.03 (VHL20) to 4.84 (HTG7), with a mean value of  $3.35 \pm 0.94$ . The observed heterozygosity values across the twelve *loci* ranged from 0.48 (NVHEQ54) to 0.89 (HTG7), with a mean value of  $0.72 \pm 0.13$ . The expected heterozygosity varied from 0.51 (VHL20) to 0.80 (HTG7 and AHT4), with a mean value of  $0.69 \pm 0.09$ . The mean PIC for these *loci* assessed from allele frequency data was  $0.68 \pm 0.09$ , ranging from 0.51 (VHL20) to 0.79 (HTG7 and AHT4) [12].

The diversity status of Rajasthan donkey population was investigated by using 20 microsatellite markers. Two of the *loci*, HMS5 and ASB17, depicted less than 4 alleles and were thus excluded from further analyses. Rajasthan donkey was found to host considerable diversity. This conclusion is evidenced by the number of alleles observed across *loci* (average  $8.16 \pm 0.89$ ), and by mean observed heterozygosity ( $0.688 \pm 0.06$ ). Signatures of inbreeding could not be detected by the FIS indices in the Rajasthan donkey population [13].

Similar type of study was conducted with brown type donkey of Andhra Pradesh. Of the 20 *loci* studied in the population, 12 *loci* were included in the final analysis, the PCR product size range varied from 76-92 bp at locus HTG6 to 257-273 bp at locus COR18. The observed number of alleles varied from 4 (VHL20) to 10 (AHT5 and HTG7) with a mean of  $6.92 \pm 1.83$ . The effective number of alleles ranged from 1.62 (VHL20) to 7.91 (AHT5) with a mean of  $4.21 \pm 2.06$ . The observed heterozygosity ranged from 0.32 (HMS2) to 0.92 (AHT5) with a mean of  $0.57 \pm 0.2$ . The expected heterozygosity ranged between 0.39 (VHL20) to 0.89 (AHT5 and HTG7) with a mean of  $0.72 \pm 0.14$ . The mean genetic diversity estimate (FIS) was 0.21 indicating moderately high levels of inbreeding. The cumulative exclusion probability (PE) of these *loci* was 0.999892 [6].

In Ladakhi donkey, a total 20 microsatellite *loci* were tested, these *loci* were of horse origin. Out of these twenty, thirteen *loci* amplified to give scorable results. The PCR product size ranged from 79–85 bp at locus HTG6 to 257–275 bp at locus COR18. The observed number of alleles varied from 4 (HTG15, HTG6, HTG10 and VHL20) to 9 (HTG7 and COR71) with a mean of  $5.92 \pm 1.80$ . The observed heterozygosity ranged from 0.44 (VHL20) to 0.90 (AHT5) with a mean of  $0.76 \pm 0.13$ . The mean genetic diversity estimate (FIS) was  $-0.076$ . The cumulative exclusion probability (PE) of these *loci* was 0.999838 indicating their suitability for parentage testing in these donkeys [8].

The grey type donkeys of Braj region of Uttar Pradesh in India were genetically characterized using ten heterologous microsatellite *loci*. At these *loci* the PCR product size ranged from 75-95 bp at locus HTG6 to 251-277 bp at locus COR18. The observed number of alleles varied from 4 (HTG15) to 10 (HTG7 and AHT4) with a mean of  $7.50 \pm 1.96$ . The observed heterozygosity ranged from 0.46 (HTG6 and NVHEQ54) to 0.79 (COR18) with a mean of  $0.66 \pm 0.12$ . The mean genetic diversity estimate (FIS) was 0.157 [14].

### Phylogenetic divergent analysis

The donkeys in India can be broadly classified in two type viz., the gray types and the brown type that are comparatively smaller and leaner. The Ladakhi, Spiti and Rayalseema donkey populations are said to be brown type while the Braj region donkeys are grey type donkeys [14]. Many attempts have been made for genetic differentiation of the donkey population of India.

Genetic characterization of indigenous donkeys' populations available in seven different geographic and agro-climatic regions in India (Gujarat, Haryana, Baramati (Maharashtra), Bihar, Rajasthan, Spiti (HP), Leh (Ladakh, J&K) was done to assess genetic diversity within and between populations using molecular markers [15]. Twenty four microsatellite pairs (AHT05, HMS06, HTG06, HMS07, HMS02, LEX4, HTG10, LEX33, HMS03, ASB17, LEX34, LEX68, COR079, VHFQ054, COR082, AHT04, COR069, COR007, COR022, SGCV28, HTG07, ASB02, COR018, LEX73) were multiplexed in five different combinations.

In the said study Gupta, *et al.*, (2018) [15] on comparing all the donkey populations, donkey from Spiti and Rajasthan were observed to be very close to each other as genetic distance among them was the least (0.0378) whereas donkeys from Leh and Gujarat areas were far apart with a genetic distance of 0.5259. Phylogenetic tree indicated that Rajasthan donkey population was very close to Spiti population while donkey population from Bihar was in close proximity with Leh donkey populations. In nut shell, donkey populations were found to be divided in 2 groups: One is having Bihar and Leh donkeys as a separate group while other group having donkeys from Gujarat, Maharashtra, Rajasthan, Spiti and Haryana.

Based on the allele frequency data at eleven common *loci*, Brown type donkeys of Andhra Pradesh were compared with Spiti donkeys of Himachal Pradesh [6]. The Nei's standard and unbiased distances was 0.32 and 0.30 which indicated genetic distinctness of these two breeds.

However, Ladakhi donkeys showed least DN and DR of 0.115 and 0.139 from Spiti donkeys. This is also evident from the fact that they are reared in similar environmental conditions and their distribution area is near [8].

Braj region donkeys were compared with three other donkey populations of Ladakh, Spiti and Rayalseema regions. These gray type donkeys of Braj region showed DNM of 0.176, 0.187 and 0.097 from Ladakhi, Spiti and Rayalseema donkeys. The three brown type donkeys of Ladakhi, Spiti, and Rayalseema clustered together with the Braj region gray type donkeys being apart [14].

#### Bottle neck analysis for different donkey population of India

As the population trend for donkeys in India shows an abridged graph, bottle neck analysis is performed in order to implement restoring measures. Most of the researchers indicated an absence of genetic bottleneck in Indian Donkey population [6,8,12,13].

When bottleneck analysis was performed for the Rayalseema donkey population, the results suggested absence of any recent genetic bottleneck in the population, though the overall heterozygote deficiency was 21% in these donkeys [6].

Sharma *et al.* (2017) [13] revealed that Rajasthan donkey population was not bottlenecked and the reason was that the population had then not undergone any reduction in population size; at least not to the extent that population deviates from mutation drift equilibrium. Study also reported the absence of genetic bottlenecks and moderate level of inbreeding in Spiti donkeys [12].

Ladhaki donkeys too suggested absence of genetic bottleneck. The authors suggest that the open mating practice and mixing of donkeys in pastures during summer months may have contributed to the absence of bottleneck in the donkeys, in spite of a decline in population of the species in the region [8].

#### Conclusion

Due to modernization and automation of the transportation, donkeys couldn't find their dignified place in policy making which had led to the decline in the population of the species. Sever conservative measures are required to be implemented for restoring the progressive bottlenecking of these animals. There are three registered donkey breeds in India and several other lesser-known populations. Indian donkeys can be broadly classified as brown type and grey type donkeys. They play a major role in Indian rural economy. After initiation of "Mission towards Zero Non-Descript AnGR of India," by NBAGR in Aug 2021, it is necessary to catalog these animals as breed and to study their genetic variability. There is a need for planned diversity study, classification, and registration of donkey population in Maharashtra and eventually in India on top.

#### Future Prospects

If the identified population of donkey is registered and welfare schemes are implemented by the government agencies, to promote the welfare of animals, the population will augment for sure. And this sincere livestock genetic resource will secure a courteous position in animal husbandry sector.

**Application of research:** The research has formed a base line data for the need to identify the donkey germ-plasm of India as a breed.

**Research Category:** Veterinary and Animal Sciences, Genetic conservation

**Abbreviations:** NBAGR- National Beuro of Animal Genetic Resources  
NGO- Non government Organization

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**Study area / Sample Collection:** Marathwada Region of Maharashtra

**Cultivar / Variety / Breed name:** Donkey

**Conflict of Interest:** None declared

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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