Review

Donkey genetic resources of India: A review

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ABSTRACT

Indigenous donkeys form an important genetic resource of India. Due to their lower cost of maintenance, these donkeys are mainly reared by poor and marginalized sections of the society. A donkey, although much smaller in size with less feed and fodder requirements, is able to generate 0.35 HP per hour, about half the power compared to that of bullock. With the improvement of road network and increased mechanization, the total population of donkeys, as per 2012 census, has decreased drastically to 3.19 lakhs showing a decline of 27.17 percent from the last census in 2007. Until recently, little information was available regarding types or breeds of indigenous donkeys. In the last few years some new populations of indigenous donkeys have been identified and characterized. Two of them, the Spiti and Halari donkeys have been registered as new breeds of indigenous donkeys. This article describes the population trends, breeds or types of indigenous donkeys identified in the recent past and the characteristics of these newly described populations.

Key Words: Attributes, indigenous-donkeys, types/breeds,
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Donkeys (*Equus asinus*) are reared in India since time immemorial. They are sure footed, docile and hard working animals. Due to their lower cost and easier maintenance, they are mainly reared by poor and marginalized sections of the society. Indigenous donkeys form an important genetic resource of India. They are primarily employed for transportation. At some places, they are also used for agricultural operations. A donkey, although much smaller in size with less feed and fodder requirements, is able to generate 0.35 HP per hour, about half the power compared to that of bullock (Ramaswamy and Narsimhan 1984, Prasad *et al*. 1990, Varshney and Gupta 1994). Despite its usefulness, easier management and efficiency, donkeys have remained a neglected species, underfed and often overlooked. By and large, donkeys have been ignored by extension services, scientists, planners and policy makers (Varshney and Gupta 1994, Behl *et al*. 2009). Until recently, little information was available regarding types or breeds of indigenous donkeys available in our country, their phenotypic characteristics and management practices (Bhat *et al*. 1981). However, in the recent past some of the new populations of indigenous donkeys have been identified and characterized. This article attempts to review the population trends, breeds or types of indigenous donkeys identified in the recent past and the characteristics of these newly described populations.

Population trends and distribution

With the improvement of road network and increased mechanization, utility of donkeys has decreased. As a result, the total population of donkeys has decreased drastically to 3.19 lakhs (Livestock census 2012), showing a significant decline of 69.8 percent compared to their population in 1956 and 27.17 percent from the last census in 2007. Taking into consideration their population trend from 1987 onwards, their population is estimated to fall to mere 1.8 lakhs in 2022 and 1.36 lakhs in 2027 (Behl *et al*. 2017a). Among the states with donkey population of at least 1500, undivided Andhra Pradesh and Telangana region has shown maximum decline of 73.04 percent in the donkey population between 2007 and 2012 followed by

Punjab (41.05), Haryana (40.55) and Karnataka (37.46). Only Tamilnadu and Uttrakhand have shown an increase of 92.31 and 19.57 percent in their donkey population during this period (Livestock census, 2007, 2012).

Rajasthan has the maximum population (81468) of donkeys possessing about 25.56 percent of the total donkey population of India followed by Uttar Pradesh (17.77), Gujarat (12.18) and Maharashtra (9.14). In terms of population density, among the states with donkey population of at least 1500, Rajasthan has the highest density of 0.238 donkeys per sq. km followed by Uttar Pradesh (0.235), Bihar (0.227) and Gujarat (0.198). Only eleven states in India have more than 5000 donkeys (Table 1).

In most of the states, the donkey population is concentrated in few districts only. For example, 91.96 percent of the donkey population of Andhra Pradesh is now confined to the districts of Kurnool and Anathapur. Similarly 64.24 percent of the donkey population of Himachal Pradesh is confined to districts of Kinnour and Lahaul-Spiti.

The Barmer district of Rajasthan with 17495 donkeys was the district with maximum donkey population in India having about 5.5 percent of the total donkey population of India. Adjoining district of Bikaner with 8712 donkeys has second highest population of donkeys followed by Agra district of Uttar Pradesh (6991), Kheda district of Gujarat (6682) and Nanded district of Maharashtra (6624). Only twenty-seven districts in India have more than 3000 donkeys (Livestock census 2012, Behl *et al*. 2017a).

As per Livestock census 2007, majority of donkey population of India (97.88 %) was of the indigenous type. In most of the states which have the donkey population of at least 1500, more than 90 percent of the donkey population is of the indigenous type except Tamilnadu, Himachal Pradesh and Uttrakhand. These three states have only 70.28, 77.14 and 87.32 percent of their donkey population of indigenous type (Table 1, Livestock census 2007).

Types of indigenous donkeys and their attributes

Till recently, the indigenous donkeys were largely

Table 1: Population statistics of donkeys in the states of India with donkey population of at least 1500 or more as per 2012 census

S. N.	State	Total donkey population	Percent of total population of India	Density per square km	Percent increase or decrease during 2007-2012	Percent of indigenous donkeys (Livestock census 2007)
1.	Rajasthan	81468	25.56	0.238	-20.23	99.06
2.	Uttar Pradesh	56643	17.77	0.235	-32.83	92.41
3.	Gujarat	38834	12.18	0.198	-22.60	99.93
4.	Maharashtra	29135	9.14	0.095	-9.15	97.99
5.	Bihar	21377	6.71	0.227	-10.72	96.74
6.	Jammu and Kashmir	17425	5.41	0.078	-27.71	98.45
7.	Karnataka	16312	5.12	0.085	-37.46	100.00
8.	Madhya Pradesh	14916	4.68	0.048	-26.15	93.90
9.	Andhra Pradesh	10517	3.30	0.065	-73.04*	100.00
10.	Tamilnadu	9183	2.89	0.071	92.31	70.28
11.	Himachal Pradesh	7349	2.31	0.132	-0.37	77.14
12.	Punjab	2909	0.91	0.058	-41.05	91.47
13.	Telangana	2909	0.91	0.026	**	**
14.	Haryana	2903	0.91	0.066	-40.55	93.90
15.	Uttrakhand	1509	0.47	0.028	19.57	87.32
16.	India	318787	-	0.097	-27.21	97.88

**Decrease in undivided Andhra Pradesh including Telangana, **came into existence after 2007*

grouped as local or *desi*. But in the last few years some new populations of indigenous donkeys have been identified and characterized. Two of them, Spiti and Halari donkeys have been registered as new breeds of indigenous donkeys. The Indian donkey populations are small sized compared to the large exotic breeds like Poitou of France (148 cm) and Catalan of Spain (136-142 cm) (DADIS-FAO). The Indian donkey populations can be broadly classified into the relatively smaller dun type and the larger grey type.

*Breeds and populations of dun type donkeys:*_The animals of dun type donkey populations are comparatively smaller in size with leaner bodies. The coat colour in majority of the dun type populations varies from dark brown to light brown. However, in some populations the main coat colour is diluted to grey-dun. The dorsal line and dorsal cross is present in all dun type animals. Some animals also show zebra markings. Among the dun type donkeys, are one registered breed i.e. Spiti and some other populations such as Sindhi, Ladakhi, Katchchhi and brown type donkeys of Andhra Pradesh.

Spiti donkey of Himachal Pradesh: The Spiti was the first population of indigenous donkeys that was registered as a breed. The Spiti donkeys are mainly distributed in the trans Himalayan regions of Spiti and Yangthang in Lahaul-Spiti and Kinnour districts of Himachal Pradesh situated at an altitude of 3000-4300 meters above mean sea level. These donkeys are comparatively smaller in size, strongly built with compact bodies, straight backs and strong legs. Body is usually covered with a thick coat of long hairs. The coat colour varies from light brown to blackish brown. The height at withers of male and female Spiti donkeys was observed to be 88.59±3.27 and 88.65±3.30 cm, respectively. Body length for male and female animals was found to be 91.0±2.88 and 90.96±2.52 cm, respectively. The mean heart girth was 100.5±5.02 and 98.58±4.23 cm in male and female animals, respectively. The tail switch is not distinguishable due to presence of thick hair. Spiti donkeys are mainly used as pack animals for transportation of dung and manure, fuel-wood and fodder from the nearby forests, construction material, trekking and camping materials for tourists (Behl *et al*. 2011, NBAGR 2013, Behl *et al*., 2017b). Gupta *et al*. (2012) has also made similar observations and have reported a height at withers of 91.89 cm for these donkeys.

Sindhi (Marwari) donkeys of Rajasthan: The Sindhi donkeys are reared in Barmer, Jaisalmer and Jodhpur districts of Rajasthan since time immemorial. The Sindhi donkeys are very strong and sure footed animals. They can easily move on sandy tracts. They can survive well in scarcity of feed and fodder which is endemic to this region. They are usually calm and easy to handle. The predominant coat colour is light brown with small percentage of brown and brownish grey animals. The bellies, ventral side of neck, inner portion of ear and legs are generally of lighter shade or white in most of these animals. The forehead is slightly convex. Nasal bone is straight to slightly concave. Eye colour is dark brown or black. The average height at withers is 98.8±3.9 and 97.9±4.9 cm in male and female animals, respectively. The body length is 93.1±5.02 and 93.4±6.45 cm in males and females, respectively. The heart girth of male and female animals is 104.3±5.35 and 106.5±5.97 cm, respectively. The tail switch is distinguishable and of darker colour in most animals. The Sindhi donkeys are mainly reared by Kumhar community and to some extent by Sansi and Bhil communities. They are used for transportation carrying load as back-pack and traction. They are also employed for ploughing (Behl *et al*. 2013). Yashpal *et al*. (2013) has also made similar observations on these donkeys who have reported the height at withers and body length of 97.55±0.58 and 97.57±0.58 cm, respectively, for these donkeys. Singh *et al*. (2007) has evaluated the performance of the donkeys of Rajasthan. They reported that these donkeys were able to carry a load of 60-90 kg as back pack to an average distance of 17.4±2.3 km in one day at a speed of 2 to 4 km/h. In traction, they were able to pull a load of 100-500 kg for 15-30 km in one day at an average speed of 6.1±0.5 km/h.

Brown type donkeys of Andhra Pradesh: The donkeys in Andhra Pradesh are mainly reared by Washerman, Chenchu and SC communities. These donkeys are mainly distributed in Kurnool and Anathapur districts of Rayalseema region. They are mainly used

as pack animals. They are predominantly of light brown to brown coat colour. The bellies of the these animals are lighter than the dorsal aspect of the body. Some animals have white markings around muzzle and eyes. The eyes are black. The muzzle and hooves are dark. The dorsal cross is present in all brown type animals which extends backwards as dorsal line. The manes along with side flanks of the neck, dorsal aspect of the ears and tail switch are darker than the rest of the body in majority of the animals. The mean heights at wither of brown type donkeys in males and females is 94.57±5.24 and 89.82±3.36 cm and body length is 91.67±5.67 and 88.36±3.36 cm. The estimated weight of the male and female animals is 80.14±14.21 and 73.69±9.87 kg, respectively (Behl *et al*., 2016). In pair wise comparison, these donkeys showed significant (P<0.05) differences from Spiti and Sindhi donkeys in most of body biometric parameters both in male or female animals (Behl *et al*. 2017c).

Ladakhi donkeys: These donkeys are found in Leh district of Jammu and Kashmir, which is situated at an altitude of 2300-5000 m above mean sea level with temperature varying from -13.53°C to 26.17°C (at Leh) and an average annual rainfall of about 10 cm. The total donkey population of Leh district is 5296. The coat colour of Ladakhi donkeys varies from light brown to dark brown and black. The bellies of these animals are white. The nasal bone is straight to slightly concave. Forehead is flat to convex. The mean height at wither of Ladakhi donkeys in males and females is 94.27±3.75 and 93.85±3.8 cm, the body lengths is 95.53±5.66 and 97.46±7.37 cm, the heart girths is 101.6±5.14 and 102.96±5.58 cm and the estimated body weight is 82.88±9.28 and 78.97±18.03 kg, respectively. The Ladakhi donkeys are mainly used as pack animals for transportation of dung and manure from animal house/enclosure to the fields, fuel-wood and fodder from the nearby forests, construction material, trekking and camping materials for tourists (Behl *et al*. 2018). Gupta *et al*. (2014) has also reported similar physical characteristics of these donkeys.

Katchchhi donkeys of Gujarat: The Katchchhi donkeys are reared mainly by the Kumbhar, Sindhi pastoralist, Vagher, Sama, Koli, Rabari and Bharwad communities. The predominant coat colour is grey-dun. The dorsal cross and dorsal line is present in all the animals. These donkeys have a mean height at wither of 95.23 cm (85-115 cm) in males and 93.37 cm (77-112 cm) in females. They are a unique germplasm adapted to the unique ecological and environmental conditions of the Katchchh region of Gujarat. They are mainly employed for transportation. They are also employed for agriculture operations like ploughing in intercropping and de-weeding in groundnut fields. They are able to survive and work in the harsh environment of this region. These donkeys have unique physical and adaptive traits well suited for the unique ecology and environment of the Kutchchh region (Personal communication 2017).

Donkeys of South-Western Bihar: The donkeys found in North Western Bihar are predominantly of grey-dun coat colour. A dorsal stripe is present on the back. The height at withers of these donkeys is 93. 6 cm (78-104 cm). The body length is 96.2 cm (84-111 cm). The heart girth is 101 cm (83-118 cm). These donkeys are mainly employed for transportation. At brick kilns, they are able to carry about 25 to 30 bricks weighing about 60-80 kg (Gupta *et al*. 2017).

Breeds and populations of Grey type donkeys: The donkeys of grey type populations are comparatively larger in size with deep bodies. The dorsal line and dorsal cross is absent in typical grey type animals. The coat colour is grey (white hairs on black skin). The grey type donkey populations include one registered breed *viz* Halari donkeys. The grey type donkeys of Andhra Pradesh is another example of this type of donkey population.

Halari donkey of Gujarat: Halari is another registered breed of Indian donkeys. These donkeys are reared mainly by Rabari and Bharwad communities of pastoralists as well as Kumhar community. They are a unique germplasm adapted to the unique ecological and environmental conditions of the Halar region situated in the Jamnagar as well as Shri Dwarka districts of Gujarat. They are comparatively larger than brown type donkeys. The coat colour of these donkeys is grey (white hairs on black skin). The dorsal cross is absent in typical animals. Muzzle and hooves are black. Nasal bone is concave in majority of

the animals. The mean height at wither of these animals is 108.04 cm (78-130 cm) in males and 107.25 cm (70-129 cm) in females. The body length is 116.7 (89-151) cm in males and 114.6 (72-152) cm in females. Heart girth is 119.4 (83-153) cm in males and 119.0 (75-152) cm in females. They are used for transportation and are able to survive and work in the harsh environment of this region (NBAGR 2019).

Grey type donkeys of Andhra Pradesh: The animals with grey coat colour, which were found to be significantly larger and heavier than the brown type donkeys are also found in Andhra Pradesh. They have well-built and deep bodies. The dorsal cross and dorsal line is absent. The eyes are black. The skin is black. The muzzle and hooves are also black. They also have small erect manes which are of the same colour as that of the body. The mean height at withers is 107.53 ± 7.5 cm and 97.0 ± 6.83 cm, in male and female animals, respectively. The body length in the male and female animals is 102.37 ± 5.28 and 95.75 ± 6.99 cm. The heart girth in the male and female animals is 115.32 ± 8.17 and 108.25 ± 5.44 cm, respectively (Behl *et al*. 2017d).

Genetic characterization of indigenous donkeys

In a breed conservation or improvement programme genetic evaluation of the concerned breed is a major pre-requisite to evaluate the variability within and between the breeds. The microsatellite markers, which are highly polymorphic, dispersed throughout the eukaryotic genome, follow codominant inheritance, can be easily amplified using polymerase chain reaction and resolved easily, are the markers of choice for evaluation of the genetic diversity of a population (Takezaki and Nei 1996, Goldstein and Shlotterer 1999). Many studies are now available that have genetically characterized the indigenous donkeys using microsatellite loci.

Behl *et al*. (2017b) genotyped the Spiti donkeys using a set of twelve heterologous microsatellite markers. The allele number and heterozygosity values observed across the studied loci indicated presence of reasonably high levels of genetic variability in Spiti donkeys. Normal 'L' shaped curve of distribution of allelic frequency classes revealed absence of any recent genetic bottlenecks in these donkeys. Evaluation of Rajasthan donkeys with a set of nineteen microsatellite loci also revealed absence of any genetic bottleneck in these donkeys (Sharma *et al*. 2017).

Similar observations were also made in Brown type donkeys of Andhra Pradesh. Genotyping of these donkeys, with twelve microsatellite loci, also revealed absence of any recent genetic bottleneck in these donkeys. When these donkeys were compared to Spiti donkeys of Himachal Pradesh on the basis of allelic frequency data at these loci they showed Nei's standard and unbiased genetic distances of 0.32 and 0.29, respectively (Behl *et al*. 2017e).

Similarly, when Ladakhi donkeys were genotyped with 13 microsatellite loci, no genetic bottlenecks were observed in these donkeys also. On comparison of these donkeys with Spiti donkeys of Himachal Pradesh and Brown type donkeys of Andhra Pradesh, on the basis of allelic frequency data at these loci, Ladakhi donkeys showed Nei's minimum genetic distances of 0.115 and 0.165, respectively, from these populations (Behl *et al*. 2019).

Gupta *et al.* (2018) also analysed genetic diversity among seven populations of the indigenous donkeys using a set of 24 microstellite loci. The breed relationship analysis based on allelic frequency data at these loci revealed genetic closeness among the donkey populations of Haryana, Rajasthan, Gujarat and Baramati regions.

CONCLUSION

The indigenous donkeys of India are smaller in size compared to exotic breeds of donkeys. Due to their smaller size, these donkeys have modest requirement for nutrition, space, maintenance and attention compared to exotic donkeys as well as other draught species. The indigenous donkeys also have amazing endurance, work capacity and efficiency compared to their size. Thus, they are well suited for the poor and weaker sections of the society, where they make significant contribution as a source of pollution free draught power. In the recent past some new populations of indigenous donkeys have been characterized. Efforts in scientific breeding can further improve their work capacity and efficiency. Further, as their population has shown continuous declining trend, special efforts are required for the conservation and propagation of these important animal genetic resources of India.

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