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Mapping the Indian donkey and mule population and potential intervention strategies and partners

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Acronyms and abbreviations

AH	Animal Health
BC	Backward Class
BKC	Brick Kiln Cart
BKP	Brick Kiln Pack
BPL	Below Poverty Line
CVSc	College of Veterinary and Animal Sciences
CSWRI	Central Sheep and Wool Research Institute
DAD-IS	Domestic Animal Diversity Information System
DUVASU	Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan
FAO	Food and Agriculture Organization of the United Nations
FC	Forward Class
FGD	Focus Group Discussion
FIAPO	Federation of Indian Animal Protection Organizations
FSSAI	Food Safety and Standards Authority of India
GOI	Government of India
HH	Household
HDDS	Household dietary diversity score
ICAR	Indian Council of Agricultural Research
ILRI	International Livestock Research Institute
INR	Indian INR
IRMA	Institute of Rural Management Anand
KII	Key Informant Interviews
LPG	Liquified Petroleum Gas
MEFCC	Ministry of Environment, Forest, And Climate Change
MOA	Ministry of Agriculture
MOFAHD	Ministry of Fisheries, Animal Husbandry and Dairying
NAAS	National Academy of Agricultural Sciences
NDDB	National Dairy Development Board
NDRI	National Dairy Research Institute
NGO	Non-governmental Organization
NLM	National Livestock Mission

NRCE	National Research Centre on Equines
NREGA	National Rural Employment Guarantee Act
NT	Nomadic Tribe
ODK	Open Data Kit
RAJUVAS	Rajasthan University of Veterinary and Animal Sciences
RHoMIS	Rural Household Multi-Indicator Survey
SC	Scheduled Caste
SD	Standard Deviation
SDG	Sustainable Development Goals
SOPs	Standard Operating Procedures
SPSS	Statistical Package for the Social Sciences
ST	Scheduled Tribe
TDS	The Donkey Sanctuary
TGC	Transport Goods by Cart
TGP	Transport Goods by Pack
TPC	Transport People by Cart
UK	United Kingdom
ULDB	Uttarakhand Livestock Development Board
UP	Uttar Pradesh
WOAH	World Organisation for Animal Health

Executive summary

The literature makes it clear that working equines contribute much to the Sustainable Development Goals through supporting the livelihood of the poorest families worldwide. Working equines are a source of employment in sectors such as agriculture, construction, tourism and mining. However, due to lack of information and statistics on their contributions in enhancing the poor people's standard of living and welfare they, particularly donkeys and mules, are underacknowledged and overlooked in policies and development programs. Efforts by various animal welfare organizations to improve the welfare of working equines alone have not achieved significant positive changes due to underlying welfare issues with their dependents. There is need for an approach that takes into account the interlinked welfare of animals and humans. In this way, changes in human welfare would bring about positive changes in animal welfare and in return, improved animal welfare would increase households productivity and income.

This study aimed to map the issues of Indian donkey and mule population and their dependents (families that own/ or work with these donkeys and mules) in the broader developmental context to identify the potential institutional innovations that would bring positive changes in animal and human welfare. The study developed a detailed methodology to map the issues of donkeys and mules and their dependent communities in India. Desktop review and focus group discussion with key stakeholders were carried out in five states where mule and donkeys are abundant to identify factors influencing donkey population trends. The Rural Household Multiple-Indicator Survey (RHoMIS), a data collection tool developed by International Livestock Research Institute (ILRI) was used.

Although the estimated donkey population in developing countries has risen over the last four decades, their population has decreased significantly in India. Recent livestock census data shows that the mule population has decreased by 67% and the donkey population by 71% compared to a decade ago. The study found that the reduced utilization of donkeys in various sectors in India was due to urbanization, social development, mechanization and lack of grazing land. Mules were preferred more in brick kiln industries than donkeys due to modernization of brick kiln infrastructure.

The study also found that donkeys and mules are owned by unprivileged communities that use these animals in breeding, brick kiln industry and transport of construction materials. Households that were involved in breeding equines were found to be the least earning and prone to food insecurity and lacking access to services such as cooking gas, electricity and animal shelters.

Among the study's recommendations is carrying out a baseline socio-economic assessment on equines in all regions of India, establishing an advocacy program to bring policy-level interventions to include donkeys in national livestock development schemes, establishing digitalized identification and monitoring system in the pilgrimage sites to achieve animal welfare and disease surveillance, and improving the health delivery system for the donkeys employed in brick kilns and riverbed mining work.

Introduction

There are an estimated 100 million working equines worldwide, supporting hundreds and millions of families (FAOSTAT 2014; The Brooke 2014). The contribution of working equines to the various Sustainable Development Goals (SDG) is evident from the Brooke report (The Brooke 2014). Working equines act as an important livelihood asset to their dependent communities and they support the SDG1 by alleviating poverty through income security (The Brooke 2015). The contribution of working equines to direct and indirect income generation is multi-faceted. They generate direct income in different sectors such as agriculture (transport of products to market), transport (people and goods), construction (transport of bricks from kilns and materials to construction sites), mining (transport of coal) etc. They generate indirect income for the owners through ploughing, fertilization of land through dung, and transportation of agriculture and livestock products (e.g. grain, vegetables and milk) to the market. This contributes to SDG 2, which targets nutrition, farming, and food production. Working equines contribute to SDG 5, which focuses on gender equality, by reducing the workload of women when fetching water and transporting wood, contributing regular income to women for household expenses and improving the social status of women to participate in social events (The Brooke 2014). Equines also contribute to SDG 6 by facilitating access to water, especially for women to fetch from hard terrain and remote regions for various household uses (The World Bank 2017). Millions of households also depending on donkeys for their livelihood, but the recent trade of donkey hide has raised concerns for SDG 15: threat to livelihood. Apart from these benefits, other studies have given evidence that working equines contribute to other SDGs including zero hunger (SDG 2) through economic support, climate action (SDG 13) through transportation and contribution to clean energy (Binda 2019).

Context and research gap

Although working equines are important for the livelihoods of people, their contribution is underacknowledged or even ignored by policymakers and program implementers because working equines are not directly involved in food production. Most of the evidence and data regarding the contribution of working equines to people's livelihoods is documented by animal welfare organizations and academicians and are often inaccessible to the policymakers and development actors. There is no large-scale information or studies for these 'other livestock', which focus on policies and schemes for their development (Behnke 2010). As a result, working equines are often not part of the national health camps for vaccination, deworming and disease eradication strategies. When the health and welfare of working equines are not addressed in policies, it leads to poor welfare of equines, which subsequently hurts the income of communities dependent on them. This can lead to a trap of poor welfare of animals as well as humans. Abundant literature evidence is available on the poor welfare of working equines including the type, prevalence and severity of welfare issues in rural and urban regions of India. (Pritchard et al. 2005). Welfare issues are severe in harsh environments such as brick kilns where dependent community people also face poor welfare (Dennison et al. 2006).

In the last two decades, many animal welfare organizations, in particular The Brooke and Donkey Sanctuary from the UK, have been working towards the welfare of working equines. However, consistent progress was not made towards this goal through various research and development interventions such as the provision of veterinary services, capacity development of owners and other stakeholders, and access to water and feed resources. The economic benefit of good animal welfare is simple if an animal is in good health and welfare as it will increase productivity and increase household income (Bekele et al. 2014). However, there are some hard-win situations where improving equine welfare is difficult and expensive (Pritchard et al. 2018). Some of the reasons reported by different stakeholders include people perceiving no social or economic benefit from caring for working equines, lack of empathy for working equines among stakeholders, areas with high animal turnover or human migration, lack of community participation, and unsafe areas where welfare measures cannot be followed etc. There is a need for innovative strategic measures to overcome this situation. One Health or welfare approach will be helpful where human and animal welfare are considered intertwined in a broad development context (Pinillos 2018).

There is a lack of attention to interventions and research towards working donkeys and mules and their dependents in developing countries. India has produced 1.09% of world equine research publications with 680 papers published from 1967–2016, mostly on the industrial race and breeding horses than working donkeys and mules (Kopperundevi 2018). Comparing data from the last two livestock censuses (2012 and 2019) shows that the population of donkeys has reduced by 61% and mule population has decreased by 57% (DAHD 2022); an alarming trend of population decline that reflects the existing breeding strategies, utility patterns, and disease outbreaks of working equines. With increasing urbanization and better road infrastructure use of working equines, especially horses and donkeys, has reduced but the use of mules is unavoidable in rugged terrain regions like highlands and in brick kilns etc. Another reason for the reduction in the donkey population could be outbreaks of glanders during the last 10 years whose acute form particularly affects donkeys (Malik et al. 2012).

To tackle these problems, there is a need for detailed mapping of the donkey and mule population, a description of communities that own them, their usage patterns, and the welfare issues of both humans and animals for a better understanding towards sustainable intervention planning. There is a need for research and evidence to prove that improved human welfare increases the animal welfare and vice versa. General extension or intervention approaches will not bring positive changes in the welfare of the equine population unless the associated challenges and opportunities within the communities that own these animals are better understood. Furthermore, concentrating only on animal welfare will not bring positive changes if the status and well-being of animal-owning communities are not addressed. The intervention measures must consider a holistic One Health approach that simultaneously addresses the human and working equines welfare issues.

This scoping study aimed at mapping the Indian donkey and mule population, their usage and contribution to livelihoods, characteristics of dependent communities, direct and indirect causes of poor animal welfare, and potential stakeholders for future partnership.

Research aims and objectives

- To identify the donkey and mule population, trend, and usage patterns in a rural, urban, and industrial development context in different regions of India.
- To specify the communities that own the donkeys and mules in different regions of the country and evaluate the human development indicators associated with these communities.
- To identify the key challenges and opportunities that impact the welfare of human and equine populations (using a One Health approach) in the areas where donkey and mule populations are high.

- To identify the different stakeholders involved in the geographical regions where donkey and mule populations are high and assess how these stakeholders can, directly and indirectly, impact the welfare of the human and equine population.

Materials and methods

The project developed a detailed study methodology to address all the objectives of this study and got approval from the Institutional Research Ethics Committee (IREC) of the International Livestock Research Institute (ILRI) with IREC reference no IREC2021-12.

Mapping the population of equines in India and factors associated with declining donkey population

To identify the factors responsible for the declining number of donkeys in India, the study followed a qualitative case study approach, which involved collating information about the declining donkey population. The inductive approach is a deliberate system where subjective information is explored with the guidance of explicit objectives (Thomas and James, 2006).

Focus group discussions (FGD) with donkey owners and traders were conducted in major states including Rajasthan, Gujarat, Uttar Pradesh and Maharashtra. The criterion for selecting these states is the drastic decline recorded in the donkey population in the last five years there. Key informant interviews (KII) were conducted with important stakeholders including government, animal husbandry department officials, non-governmental organizations (NGOs) and community organizations working for equine welfare, animal activists, scientists from research organizations and members of start-up organizations involved in promoting the donkey milk value chain (Table 1). The information collected through the FGD and KII were entered into a Word file and theory was derived from these documents and analyzed towards the study objectives.

Table 1. Quantitative sampling criteria for data collection in select four states in India

Stakeholder	Organization/ institution	Number of persons interviewed				Data collection tool
		Maharashtra	Uttar Pradesh	Gujarat	Rajasthan	
Veterinary officers	Animal husbandry department	5	1	-	1	Key informant interview
Academic officials/ research scientists	Veterinary college/ research institute	4	1	-	-	Key informant interview
Donkey owners/ traders	Donkey users	15	8	12	13	Focus group discussion
NGO field staffs	NGOs	3	2	-	-	Key informant interview
Others (traders, brick kiln owners)	-	1	1	1	-	Key informant interview

Mapping and characteristics of communities that own donkeys and mules

Research methods and tools

Data collection was conducted by a team of enumerators that were recruited and trained in the Rural Household Multiple-Indicator Survey (RHoMIS) data collection tool, which is integrated into the Open Data Kit (ODK) software application for data collection and cleaning. The RHoMIS tool is a standardized farm household survey tool used to assess the household's farming practices, food consumption, livestock details and income indicators¹. For this study, an additional equine-related module was included to assess the equine-related constraints and issues. Training of enumerators was conducted for five days for testing the tool and standardizing it. A consent form was obtained from each household before collecting the data using this tool.

Sampling plan

The household survey was done in the states with a significant working equine population (donkeys, mules, ponies and horses) and the households were selected according to the dominant work type and species; some households owned donkeys or mules only and some households with both donkeys and mules were included in the study. The survey collected data on the proportion of working equines used for specific work types i.e., cart or pack animals and in different sectors like brick kilns, construction, pilgrimage, sand mining and for specific purposes such as pot-making with clay, breeding and pastoralists. The survey was done in states where there is a predominantly mixed equine population, and the work types and sectors are varied. Work type was the main criterion for the selection of households to collect data that can inform policy on the welfare issues of working equines. The socio-economic conditions and equine welfare issues (overloading, overworking, harnessing, the weight of the donkeys in proportion to the loading capacity, lameness, and harness-related wounds) are different in different work types and severe in some sectors, especially the brick kilns. It was vital to collect such data for a better understanding of the welfare issues and to find collective actions to improve the condition of the animals used for that work.

Sample size calculation

We sought to calculate the sample size per work type (pack or cart) and sector (brick kiln and transport), which would, ideally, be equal across all sectors. However, knowledge of the work types and sectors suggested that the population of animals kept for transporting people, pilgrimage, tourism and breeding was a lot smaller. Therefore, it was decided to take half the sample size for these populations, assuming that variation in key indicators would also be lower. The sampling of households was distributed proportionately, associated with the existing work type in the existing equine population across states. As the exact population with work type was not available. The sampling was done based on the experience and secondary sources in these states.

To calculate the required sample size, we considered the key indicators of the proportion of income from equines (importance), the proportion of equines that died in the past 12 months (welfare), the proportion of equines with good vs. bad welfare (welfare) and household dietary diversity score (HDDS). The study estimated these with reasonable precision for each work type. A one-sample normal or binomial equation was used to calculate the sample size (N) required for each work type, estimating the precision (+/- X) with 95% confidence. A summary is shown in Table 2. No adjustment was made for intra-cluster correlation within a state as we think this was very small.

¹ <https://www.rhomis.org/>

Table 2. Sample size calculation for RHoMIS household survey

Indicator	Estimated (p)	Precision	N (work types 1 – 4) **	N (work types 5 – 8) ***	N (all work types)
Good/bad welfare	30%	+/- 10%	81		
Proportion of animals that died in 12 months	25% (work types 1–4); 15% (types 5–8)	+/- 7%	147	100	N/A
Indicator	Standard deviation	Precision	N (work types 1 – 4)	N (work types 5 – 8)	N (all work types)
Proportion of income from equine	70% of the mean (work types 1-4); 50% (types 5-8) *	10% of the mean	189	97	
HDDS	2.4*	0.5*	89		

*Taken from other studies

**Work type 1-4: 1-Brick kiln cart (BKC) 2-Brick kiln pack (BKP) 3-Transport of goods by cart (TGC) 4-Transport of goods by pack (TGP)

***Work type 5-8: 5-Transport of people by cart (TPC) 6-Breeding (B) 7-Tourism (BKP) 8-Pilgrimage

From the above sampling calculations, we rounded up to take 200 households for the common work types (1–4) and 100 for the uncommon work types (5–8). Tourism and pilgrimage were dropped from sampling due to the COVID-19 conditions which made it difficult to find these work-type households.

The survey was done in 6 states including 5 where the donkey population is dominant and Uttarakhand where the mule population is high. The 2019 livestock census has highlighted the drastic reduction in the donkey population across these states. A total of 898 households were sampled (Table 3). As the population of donkeys is higher in Uttar Pradesh, 31% of samples were selected from this state followed by Rajasthan, Maharashtra, Gujarat, and Bihar, respectively. In the work type, pack animals were dominant in sampling especially pack animals of brick kilns (28%) and transport of goods (28%). Figure 1 depicts the places from where data were collected. Figure 2 gives details of the samples with work type from various regions. Most of the donkeys working in cart type are found only in Rajasthan and used for the transportation of vegetables, fruits and goods from markets and villages. In Uttar Pradesh, all work types are found for mules and donkeys. Brick kiln work types are found in Uttar Pradesh, Maharashtra, Gujarat and Bihar. Sampling was reduced to 898 due to transport restrictions and farmer availability due to the COVID-19 pandemic.

Table 3. Sampling for RHoMIS household survey according to region and work type

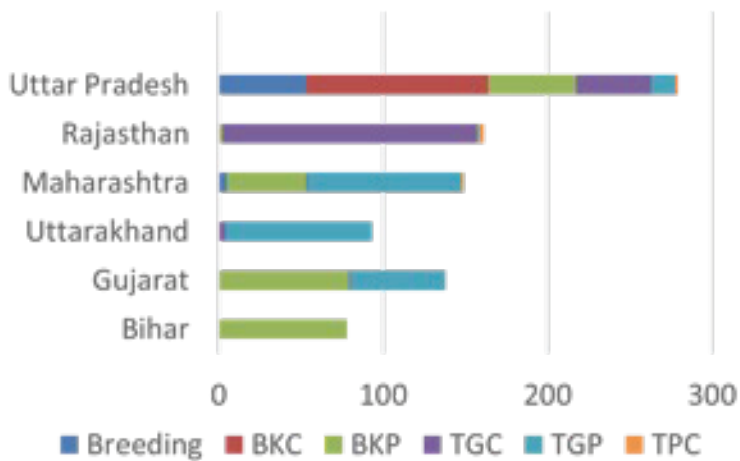
Region of samples			Work type of samples		
Region	No of households	% of households	Work type	No of households	% of households
Bihar	78	8.7	Breeding (B)	58	6
Gujarat	138	15.4	Brick Kiln Cart (BKC)	113	12
Uttarakhand	93	10.4	Brick Kiln Pack (BKP)	260	30
Maharashtra	149	16.6	Transportation of goods by cart (TGC)	207	23
Rajasthan	161	17.9	Transportation of goods by pack (TGP)	257	28
Uttar Pradesh	279	31.1	Transport of people by cart (TPC)	5	1
Total	898	100		898	100

Figure 1. Location of household surveys.



Source: Own survey data, ODK/ONA database, ILRI

Figure 2. Work type samples within states for the household survey.



Data analysis

The data from ODK was transferred to the Statistical Package for the Social Sciences (SPSS) and statistical analysis was carried out to describe the characteristics of equine-owning communities and their constraints.

Identification of potential partners/ stakeholders for intervention

The study planned for stakeholder meetings in six states, however, only four stakeholder meetings were held in four states due to the COVID-19 outbreak and time constraints. One national-level stakeholder meeting was organized in New Delhi. The details of the stakeholder meetings are presented in Table 4.

Table 4. Methods and details of stakeholder meetings in Delhi and other states

Region	Date and venue	Number of participants	Number of institutes/organizations that participated	Mode of discussion
Rajasthan	13 December 2022	50	Research institutes	<ul style="list-style-type: none"> • Technical session
State-wise stakeholder meeting at Bikaner	ICAR-National Research Centre on Camel, Bikaner, Rajasthan		<ul style="list-style-type: none"> • ICAR-National Research Centre on Equines (NRCE) • ICAR-National Research Centre on Camels (NRCC) • RAJUVAS, Rajasthan • ICAR-Central Sheep and Wool Research Institute (CSWRI) • ILRI • Bahula Naturals • The Brooke India • Equine owners • Camel owners 	<ul style="list-style-type: none"> • Socio-economic condition of donkey-owning communities • Factors associated with a declining population • Importance of donkey milk for human nutrition and child development • Panel discussion
State-wise stakeholder meeting at Uttarakhand	26 November 2022	60	<ul style="list-style-type: none"> • Animal Husbandry Department • Animal Welfare Board • Uttarakhand Livestock Development Board (ULDB), Uttarakhand • Equine owners • ILRI • The Brooke India 	<ul style="list-style-type: none"> • Technical session • Socio-economic condition of donkey-owning communities • Factors associated with a declining population • Importance of donkey milk for human nutrition and child development • Panel discussion

State-wise stakeholder meeting at Uttar Pradesh	23 November 2022	65	<ul style="list-style-type: none"> Animal Husbandry Department Livestock Development Board Equine owners ILRI The Brooke 	<ul style="list-style-type: none"> Technical session Socio-economic condition of donkey-owning communities Factors associated with a declining population Importance of donkey milk for human nutrition and child development Panel discussion
State-wise stakeholder meeting at Maharashtra	4 March 2020	35	<ul style="list-style-type: none"> College of Veterinary and Animal Sciences (CVSc), Parbhani ILRI ICAR-NRCE State Animal Husbandry Department The Animal Rahat (NGO) Dharma Donkey Sanctuary Equine owners 	<ul style="list-style-type: none"> Technical session Overview of donkey population and factors for the declining trend Mechanization to replace donkeys in brick kilns in Sangli (case study) FGD on different interventions and impact on working equines
State-wise stakeholder meeting at New Delhi	10 October 2022	33	<ul style="list-style-type: none"> ICAR, ICAR-NRCE, ILRI Department of Animal Husbandry and Dairying National Academy of Agricultural Sciences (NAAS) ICAR-National Bureau of Animal Genetic Resources (NBAGR) Federation of Indian Animal Protection Organization (FIAPO) DUVASU, Mathura Agrinnovate Uttarakhand Livestock Development Board (ULDB), Government of Uttarakhand The Brooke India The Animal Rahat 	<ul style="list-style-type: none"> Technical session Socio-economic condition of donkey-owning communities Factors associated with a declining population Importance of donkey milk for human nutrition and child development Panel discussion

Results and discussion

The findings of the scoping study are presented in three parts: the factors associated with a declining population, characteristics of equine-owning communities, and the major constraints and potential stakeholders to address the challenges of equine-owning communities to achieve the welfare of donkeys and mules.

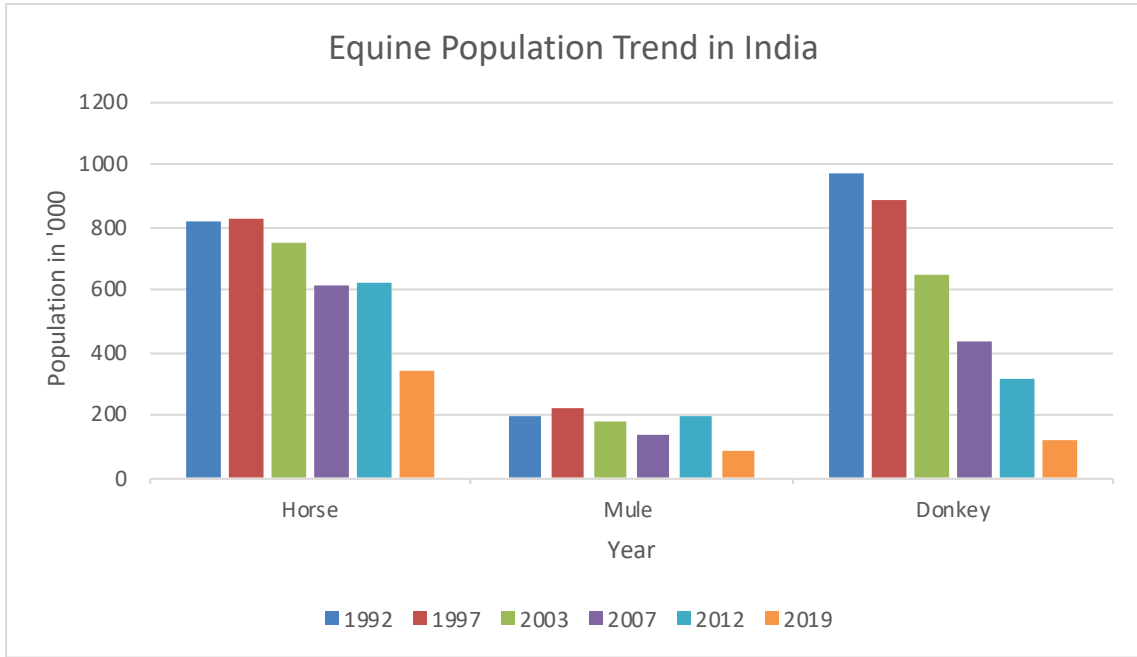
Mapping population of donkeys and mules in India and factors associated with the declining donkey population

Donkey population trend: the world in general and specifically in India

According to Fielding and Starkey (2004), even though data on donkey numbers is gathered and maintained by respective agricultural ministries nationally, the accuracy of the estimated donkey population in India is contentious. Based on this information and through linear approximation global donkey numbers are interpolated by the Food and Agriculture Organization of the United Nations (FAO). This is because these work animals are mostly found in rural remote areas which are either difficult to survey or there is a lack of any records on ownership of these animals (Fielding and Starkey 2004). Based on the donkey population data available on the FAO website, it can be concluded that the world witnessed an increase in the donkey population starting in 1961. The donkey population increased from 38 million in 1968 to 50 million in 2018 (FAOSTAT 2019). While the world donkey population has shown an upwards trend, there are large regional differences, for example, most of the donkeys were found in sub-Saharan Africa, the Northern region of the Indian subcontinent and Latin America (Starkey and Starkey 2000).

Since 1951, the Department of Animal Husbandry and Dairying under the Ministry of Agriculture, Government of India (MOA) has been carrying out the countrywide livestock census every five years. Although the estimated population of donkeys in developing countries has risen over the last four decades, their population has decreased significantly in India (FAOSTAT 2008; FAOSTAT 2018). In 27 years, India registered an almost 88% decline in donkey population from 967,000 in 1992 to 120,000 in 2019 (DAHD 1992 and DAHD 2019). The horse population also has registered a gradual decline over the years, unlike mules whose population showed a rising trend in 2012 (Figure 3). This increase in mule population was particularly in northern India, where mule traction is particularly used in the brick kiln industry and for tourism purposes at pilgrim sites. However, the last livestock census (2019) showed the mule population had declined by 67% and that of donkeys by 71% compared to the 2012 livestock census.

Figure 3. Equine population trend in India from 1992 to 2019.

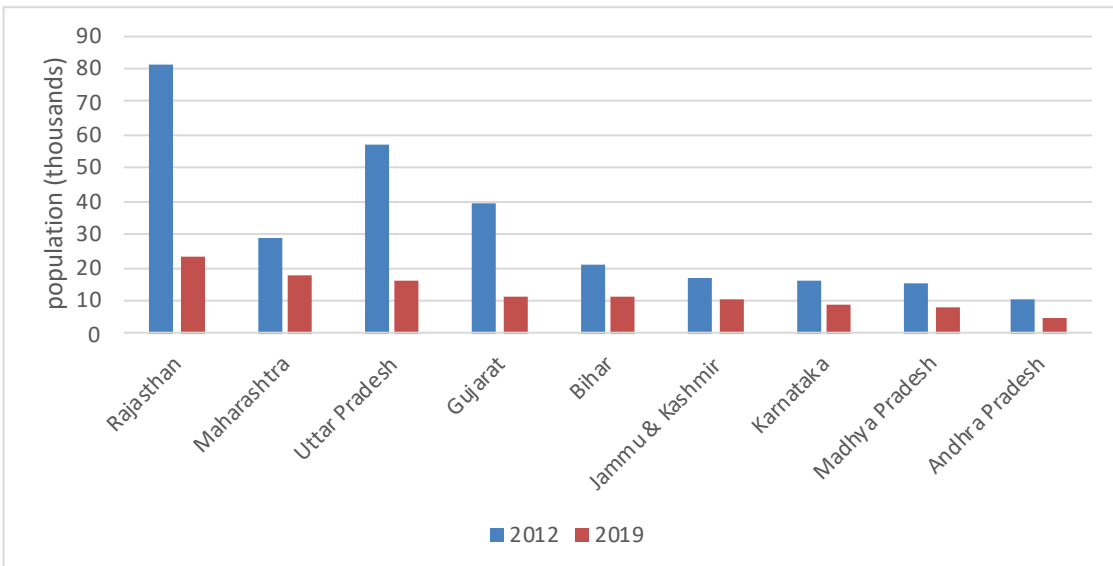


Source: Livestock census data.

Declining trend in different regions of India

As depicted in Figure 4, the declining trend of donkey population is further varied across the states in India, with the biggest decline in donkey numbers in Rajasthan (71.3%), Uttar Pradesh (71.7%) and Gujarat (70.9%) between 2012 and 2019.

Figure 4. Donkey population trend across various states in India from 2012 to 2019.



Source: Livestock census data

Lack of donkey breed information

The low priority accorded to donkeys as livestock is evident from the lack of data available on their breeds and related information. For example, of the 0.12 million donkeys in India, only two registered donkey breeds, Halari and Spiti are reported by the National Bureau of Animal Genetic Resources of the Indian Council of Agricultural Research (ICAR-NBAGR 2020). The Domestic Animal Diversity Information System (DAD-IS), which is the searchable database of FAO on breed-related information mentions three donkey breeds namely Indian, Indian wild ass, and Kiang with no additional information on their morphology, prolificacy or management conditions (FAO 2020).

Factors associated with the declining donkey population

Lack of utilization and declining biodiversity

Despite having 2.4% of the total land area in the world, India contributes almost 8% to the global biological diversity including plants and animals (Sahoo and Sahu 2019). A loss in the biodiversity of livestock species may be also associated with their less utilization (Henson 1992). The reduced utilization of equine species in different industries in India has been recorded due to various factors including urbanization and social development. For example, donkeys were preferred for work by brick makers for carrying bricks, for the transportation of construction materials in urban and semi-urban areas, carrying sand from riverbeds to construction sites, carrying goods and materials for pastoralists in rural areas, conveying stones and materials from mines and quarries, and for delivering goods in mountain regions and pilgrimage sites. There has been a remarkable change in the aforesaid trend and the use of donkeys has decreased considerably in the sectors due to increasing mechanization in industries, preference for mules and horses over donkeys, local perceptions and lack of interest among youth in donkey-owning communities, among other factors.

The trend of donkey use in brick kilns

India is the world's second-largest producer of bricks and this demand is expected to increase three to four times by 2050 (Maithel and Kumar 2019). The sector contributes 0.7% of the country's gross domestic product and supports other sectors including the transportation and construction industries. There are three types of brick kilns in India: the first is the traditional intermittent kilns where small-scale brick production is carried out with minimum human labour and animal traction; the second type is the traditional continuous or funnel kilns where solid hollow perforated bricks are produced through efficient fuel use. This includes movable and immovable chimney bulls trench kilns, zigzag kilns and vertical shaft kilns. These types of kilns deploy maximum animal traction to frequently transport bricks in and out of kilns. The third is the advanced continuous brick kiln (Tunnel, Hoffman, Hybrid Hoffman and Cedan) where large-scale brick production is followed by efficient fuel use through electricity and high-water use with no use of animal traction at all. The Bureau of Energy Efficiency in India and the pollution control board are promoting the brick kiln sector to adopt the Energy Efficient Enterprise (E3) mark, which produces hollow bricks for sustainable infrastructure development and causes less pollution (Maithel and Kumar 2019). This entails a change from fixed bull trench tunnel kilns to zig-zag kilns.

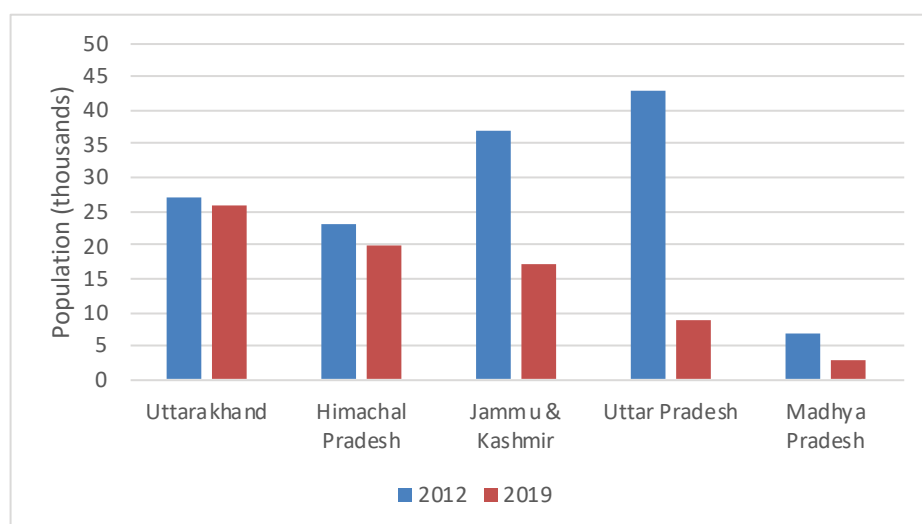
Donkeys were preferred for work in brick kilns due to their sturdiness in difficult terrain and challenging environments. According to Mitra (2017), an estimated 380,000 draught animals are employed in the brick kiln industry in India alone. Focus group discussions with brick kiln animal equine owners and interviews with key stakeholders indicated that brick kilns around metropolitan cities are advised to convert the brick kilns from traditional to continuous zig-zag types, which have a different architecture around the chimneys to allow accommodation of more bricks for efficient fuel use. These changes lead to elevated brick stacks which are inconvenient for donkey owners as they cannot throw the bricks at a higher elevation. In this modern scenario, mules or horse carts are preferred over donkeys. A mule owner near Dadri brick kiln in Maharashtra narrated his plight on the change in animal ownership from donkey to mule owing to the refurbished kiln design.

I come from a neighbouring village and have been working in this brick kiln, along with my family members, for the last two decades. I owned 10 donkeys three years ago and sold them to buy just one mule as the brick kilns in this region have changed. The modern structure isn't suitable for donkey work anymore. I was better off as a donkey owner than a mule owner because we had the option to rest one animal and use another one during the long and hard-working day. With just one animal, I can only tend to a few hours of work until the mule is tired or sick. This is my primary source of livelihood, and I cannot afford to lose this mule as my whole family would suffer in hunger and poverty. — Mule owner 1, Dadri brick kiln, Uttar Pradesh.

The states of Delhi, especially around the national capital region (NCR), and Uttar Pradesh (UP) housed thousands of brick kilns where animal traction was used for transporting bricks in and out of kilns. Modernization of brick kilns drove the donkey owners to sell their animals to purchase mules as 6–8 months of seasonal work, in the brick kilns, is their primary source of livelihood. Earlier known as bear tamers, the *Qalandar* community in UP has taken to breeding mules as their primary source of income. During the focus group discussions in UP, with an equine breeder from this community, it was revealed that they took to breeding horses and donkeys for mule production to serve an increased demand for mules in the brick kilns industry. It was shared that mules are also favoured over donkeys for the transportation of pilgrims and luggage in mountain regions as they can carry more weight and can be efficiently carted. This has led to a rise in demand for mules, which is evident from the increasing number of buyers who visit the equine trade fairs in UP and other north Indian states.

A contrasting trend is, however, evident from Figure 5 which reveals that a sharp reduction of 57.1% (from 200,000 to 84,000 animals) in the mule population was also registered between 2012 and 2019 respectively (DAHD, 2019). Overall, there has been an overall reduction in both the donkey and mule population which contradicts the aforesaid statements of donkey owners about acquiring mules for donkeys for work in the brick kilns. However, it is evident that mules are more abundant in a few states in India. According to Figure 5, the number of mules in the pilgrim sites especially in mountain regions like Uttarakhand, Himachal Pradesh and Jammu Kashmir, has remained steady because of their use in transporting pilgrims, goods and materials in the difficult terrains.

Figure 5 Population trend of mules across different regions in India (2012 and 2019).



Mechanization in brick kilns

Another important reason for the reduced use of equines in brick kilns is mechanization. Brick kiln owners are known to rent out small three-wheeled vehicles to donkey owners for transporting bricks in and out of kilns. During an interview with some donkey owners in Maharashtra, it was revealed how traction from donkeys has been replaced by three-wheelers, which are more efficient even though donkeys are still used occasionally.

This working season I only have four donkeys. The brick kiln owner has rented us a three-wheeler for transporting bricks. The rent money is deducted from the daily wages we earn. This vehicle helps me transport more bricks per round and I tend to earn more than what I made using donkeys. I can, however, not afford to buy this vehicle immediately. My use of donkeys has not ceased completely as I use them when the vehicle is under repairs. The burden on our children to assist in the brick kilns has also been reduced as vehicles can only be driven by adults. — Donkey owner 2, Maharashtra brick kiln.

In the brick kilns located near villages or semi-urban areas, brick-kiln owners hire small trucks for transporting bricks. The truck owners are paid daily for the hired vehicle. The net income per person, earned by brick kiln workers, is higher while working with a vehicle compared to using donkeys for work. This is also in favour of donkey welfare as work conditions in the brick kiln industry are highly demanding both for the animals as well as their owners (Pritchard et al. 2018a). There are, however, environmental implications due to mechanization as reported in earlier studies in a different industry. A research study reported a peak in emissions during the transition from animal traction to mechanization in the agriculture sector during the post-war period in Spain (Aguilera et al. 2019).

The response from community members at the Star Vavol brick kiln near Ahmedabad, Gujarat, was mixed. The donkey-owners migrated from other districts within the state whereas other labourers in the brick kilns have migrated from other states including Chhattisgarh, UP and Rajasthan. Some donkey-owning communities stated that earlier they owned 5-6 donkeys for seven years but now they own 10-12 donkeys as there is more labour within their households. These communities are dependent on soil excavation work, and have no skills for other types of work. If they work in their villages, they earn only half the income per day and the labour in the village is not guaranteed every day. In the past, these individuals would sell their donkeys at end of the season if there was difficulty in feeding and grazing in their villages. Due to the COVID-19 pandemic, these donkey owners have lost their livelihoods as the brick kiln owner has since stopped brick production and many have sold their donkeys to the pastoralist Raval communities that keep donkeys and other livestock to transport goods for a few months and later sell the donkeys when their demand is high or for cash during emergencies.

Donkey prices are increasing each year due to decreased population of donkeys, we are not sure why donkeys are decreasing but we heard that donkeys are stolen or bought in bulk by some traders who sell them for slaughter, and we have to pay 8000 to 10,000 INR to get one donkey which is double the price compared to 3-4 years ago. — Donkey owner, VK Ambapur brick kiln, Gujarat.

Increased mechanization is reported due to the increased cost of purchasing donkeys.

The tractors are preferred over working with donkeys because of the non-availability of donkeys and the increased price of donkeys. It will cost us around one lakh Indian INR (USD 1,300) to buy 8-10 donkeys which is the minimum viable herd size, in which we can buy a tractor on loan, and we can earn more. — Donkey owner, Star Vavol brick kiln, Gujarat.

This view was also supported by a donkey owner in Rajasthan.

Nowadays there are fewer donkeys at the equine fair, so there is a very high price for them. Five years ago, I owned six donkeys, now I am working with four due to their high price and the young generation does not prefer to work with donkeys. There is less labour to work with donkeys, so I have reduced them. —Donkey owner, RBR brick kiln, Sirohi, Rajasthan.

However, some brick kiln owners do not prefer tractors for the transport of bricks into the kiln. Another donkey owner explained the reason for this:

We will work only with donkeys next season as well because our brick kiln owner prefers donkeys instead of tractors. There is more breakage/wastage when loading and unloading if tractors are used. This does not happen when donkeys are used. — Donkey owner, Star Vavol brick kiln, Gujarat.

Use of donkeys in urban and peri-urban regions

Donkeys are used in urban and peri-urban regions for the transport of goods and construction materials. For example, in Rajasthan, donkeys are used daily for transporting goods such as vegetables and fruits from peri-urban farms or villages to the cities or nearby towns and vice versa. Donkeys are also used to transport sand from riverbeds to construction sites. The construction industry in Maharashtra, a southwestern state in India, has a unique livelihood pattern among certain communities. Donkeys are employed to transport excavated sand and gravel mixture from riverbeds to construction units that manufacture concrete pillars. The harsh nature of this work requires the animals to work continuously for eight or more hours with their hoofs swamped in grime and water. It is common to observe lameness in these animals due to softening of hooves and hoof abscesses caused by the prickling of gravel and thorns. Constant rubbing of the harness around the soft skin of the animals, caused by wet conditions, also causes wounds.

Reasons for declining donkey population in river-based livelihoods

Group discussions with six households that are dependent on donkey labour for sand transportation in Maharashtra, revealed a decrease in donkey ownership in their communities. These communities belonged to Nomadic Tribes '*beheras* or *palki* bearers' who in the past worked as palanquin holders for royal families. After the abolishment of kingdoms, these communities adopted the river-based livelihoods of excavating and supplying sand for the construction industry. Some of them are also involved in washing clothes for higher caste communities. In the surveyed region, approximately 15 donkey-owning families were working as washermen/women and over the last 10 years only half of them continue owning donkeys. During discussions with these families, it emerged that even here the decline in the donkey population is attributed to mechanization. The excavation and transportation of sand from rivers is now done using earth movers and tractors, making the occupation cheaper and easier. In some regions, however, the poor or lower-middle-class communities still hire the services of donkey owners for sand supplies. The recently enacted laws and regulations demand legal permission from the authorized officer, detailing the quantity of sand required for construction posts that the donkey owners can harvest from riverbeds. There are several instances where donkey owners are illegally hired to harvest sand, which exposes them to arrest and legal action. Donkey owners reported that they are subjected to harassment and must pay penalties on behalf of the hiring party. These donkey owners usually belong to lower castes and are prejudiced. They have low bargaining power to speak up for their rights.

'There are regular raids around the riverbed sites. When the house owners do not have legal permission for sand lifting, we get caught by the police and end up paying penalties for no fault of ours.' — Donkey owner 3, Poorna, Maharashtra.

The other reason for the declining donkey numbers in this community is theft. The interviewees shared that donkey meat consumption is preferred by certain communities in the adjoining state of Andhra Pradesh and the border areas. Because of this, it is a common practice by traders to steal donkeys during the night. The donkey owners added that attempts to trace their stolen animals in Andhra Pradesh are mostly unsuccessful because these traders are very influential.

There are some communities in Andhra Pradesh that eat donkey meat as it is believed to increase strength and libido. We do not have a shelter to tether our donkeys at night and they are stolen by traders who sell them in the bordering state of Andhra Pradesh. This trend has been on the rise for the last five years. The donkey owners cannot afford to buy new animals and therefore opt out of this occupation. They have either set up local food-selling enterprises or work as daily wage labourers in neighbouring villages and districts. — Donkey owner 4, Poorna, Maharashtra.

Another reason for the declining donkey population is the comparative advantage of earning a better income as a daily wage labourer compared to a donkey-based livelihood. An average family in this community, comprising 4-5 members, owns 8-10 donkeys and earns approximately INR 1,200-1,500 (USD 14-18) daily using donkeys. The average income per member per day is INR 300-400 (USD 4-5 /day) which is less than the daily wage for a labourer of INR 500 (USD 6-7/day) per member per day. Some of the donkey owners reported that they have diversified their livelihoods with their wives and children engaging in small enterprises to make extra earnings. They shared that donkey ownership is not viewed as a respectable occupation and their children are not willing to live miserable lives owning and working with donkeys.

Sand lifting from riverbeds is a seasonal activity concentrated from December to May. During the remaining months, men migrate to neighbouring areas to work as daily wage labourers while women set up small enterprises by preparing snacks from frying peanuts or chickpeas. The sons in the family sell these snacks on the roadside and for income. Children feel that this is a respectable occupation compared to working with donkeys. No child wants to be called names for owning and keeping a donkey. — Donkey owner 5, Poorna village, Maharashtra.

The caste system still holds strong in most regions of India and is also associated with dictating the type of animals reared by communities. For example, ownership of donkeys and dogs is considered to be with the poorest and lower caste people belonging to the Scheduled Caste (SC) and Scheduled or Nomadic Tribes (ST/NT) and giving up working with donkeys could be a way to renounce the set hierarchies (Hoff and Pandey 2004).

Glanders and declining number of donkeys

Glanders is a fatal infectious disease in equines and is caused by *Burkholderia mallei*, a gram-negative bacterium (OIE 2018). There are three types of clinical forms of glanders observed in equines namely nasal, pulmonary and cutaneous forms. Depending on the severity of onset, the disease is divided into acute and chronic forms (Malik et al. 2012; Khan et al. 2013). The acute form is observed in donkeys and to some extent in mules. Horses become asymptomatic carriers and act as a source of infection spreading it to mules and donkeys. Mules, being a crossbreed of horses and donkeys, tends to exhibit both acute and chronic forms (OIE 2018). A recent study in India confirmed the seroprevalence of this disease from 2015-2018. According to this study, 64 asymptomatic carrier animals tested positive comprising 51 horses and 11 mules (Singha et al. 2020). Another study indicates an increase in seroprevalence from 0.62% in 2015 to 1.2% in 2018 (Singha et al. 2020). The total number of animals tested in this study period from Northern India was 73,704 of which 731 cases tested positive for glanders infection. Of the total reported cases, 538 were from Uttar Pradesh followed by 71 from Jammu and Kashmir and 60 from Delhi. In western India, a greater number of positive cases were found in Gujarat (n=98) followed by Rajasthan (n=33) and Maharashtra (n=22) out of 23,351 equines tested for seroprevalence. An outbreak of glanders was reported in 2006 in Uttar Pradesh, which has high mule production by the *Qalandar* community and sells equines to other parts of India. Of the total sample size of equines tested for seroprevalence (Singha et al. 2020), horses constituted 70% of the sample with mules and donkeys constituting the other 20 and 10% respectively. This study did not provide details of positive cases in donkeys. According to the WOA, donkeys contract the acute form of glanders leading to high mortality and donkey owners tend to lose their animals before availing any test results. In the 2006 outbreak of the disease, it is likely that several cases were not reported by donkey owners, especially those with the east bargaining power to access veterinary health care provided by government.

Decreased grazing land

India lost 31% (5.65 million hectares) of its grassland area within a decade (UNCCD 2019). For example, grasslands in the Aravalli range in Rajasthan underwent severe degradation². Other states where land has been severely denuded include Maharashtra, Karnataka, Gujarat and Uttar Pradesh. Loss of grazing land can be attributed to both direct and indirect drivers. Direct drivers of grazing land loss are overgrazing, poor management and deforestation. Indirect drivers

2 <https://www.downtoearth.org.in/news/climate-change/aravallis-a-mountain-lost-63811>.

include the conversion of pastures into croplands through encroachment, diversion and allotment driven by increasing population pressure. The country also lost around 19% of its common lands during the same period, according to the report. The area under common lands decreased to 73.02 million hectares from around 90.5 million hectares between 2005 and 2015.

Donkey owners graze their animals on common lands including grazing grounds, forests and land near ponds, rivers, and wastelands near villages or surrounding brick kilns. These common property resources are readily being lost to encroachment, conversion to agricultural land or for housing to accommodate the increasing urban population, leaving little or no grazing spaces for donkeys. In urban areas, the lack of grazing spaces leaves the donkeys to feed on garbage, which causes colic and other ailments. Donkey owners in Maharashtra brick kilns purchased sugarcane tops to feed their donkeys in the absence of any grazing areas. The owners reported an increase in the cost of feeding donkeys, in the last five years, due to decreased common wastelands or grazing areas. The decreased feed resources have pushed many donkey owners to reduce their herd sizes and find alternative livelihood options. Elsewhere, the nomadic pastoral tribes Rebari in Gujarat and Raika in Rajasthan that keep donkeys for the transportation of goods, materials, and people increasingly travel long distances in search of grazing areas making their donkey-based livelihoods harder to sustain.

Implications of declining donkeys

Loss of income and alternate livelihood for donkey-dependent communities: Sudden loss of donkeys due to disease, drought, and theft leads to decreased income for poor donkey owners. They must find an alternative livelihood to meet their household needs. Those working in the river-based livelihoods for the transport of sand in Maharashtra reported that they now keep fewer donkeys.

Only a few households own donkeys nowadays due to their theft and strict restrictions for sand excavation. We have started alternate livelihoods like daily labour, small business such as selling snacks. We are also educating the next generation and moving to other cities for employment. — Donkey owner, Poorna, Maharashtra.

On the other hand, donkey owners from Gujarat brick kilns reported that they have to find labour work in their villages when they go back home and most of them are landless. They are skilled to work in jobs related to the soil like excavations, clearing debris etc., but they are unable to find regular labour work due to the scarcity of jobs and surplus labour in their region. One of the donkey owners reported that he will learn to drive in 1-2 years so that he can work with tractors and lorries in the brick kiln.

The decreasing donkey population affects the poorest communities which depend upon the animals for their livelihood. A government veterinarian in Sirohi, Rajasthan reported that

Marginalized donkey owners are solely dependent on donkeys and are suffering more due to less availability of donkeys. These owners are facing economic crises for their families. These people seek alternative livelihood through daily wages in construction and transportation and alternative jobs availed by the National Rural Employment Guarantee Act, 2005 (NREGA) work program.

At the same time, there is a high tradeoff between human and animal welfare in brick kilns due to migratory communities, the poor social status of donkey owners and the hard terrain and environment (Pritchard et al. 2018b). This leads to poor animal welfare which affects the productivity of working equines in the country.

Loss of genetic biodiversity of donkeys: Donkeys are crucial for breeding purposes because they can produce mules, which are essential for working in rough terrain like mountains and brick kilns. In India, mule production is carried out by qalandar communities whose livelihood is based on equine breeding. The decreasing donkey population across the country is a serious cause of concern regarding the loss of genetic diversity, which is thought to be the result of a lack of

policy measures to conserve donkey breeds. Little information is available regarding different donkey breeds and their phenotypic characteristics in India (Singh et al. 2007) despite recent studies that have characterized some donkey breeds in India including Spiti donkeys in Himachal Pradesh (Behl et al. 2017) and genetic evaluation of donkey breeds from different agro-climatic zones (Gupta et al. 2017).

Socio-economic characteristics of communities owning donkeys and mules

This section categorizes the socio-economic characteristics of communities that own donkeys and mules that were recorded in the study. The study found just five households that use mules for the transport of people by cart (TPC), a negligible sample, so they were excluded from the analysis.

Household characteristics

The study found that the household heads were middle-aged (35-40) among all work-type households (Table 5). Among all work types, only 2% households of breeding work type were found with only men in the household. Fourteen per cent of households were found with lone men in brick kiln cart work types, this might be due to some types of work being difficult for women to do, e.g., working with carts so women stay back in their villages to take care of children and any agriculture activities. Those communities that own breeding type and brick kiln pack animals were found with a greater number of children (2.9) than the other work type communities (2.6). A greater number of children were found in Bihar and UP (2.6) and the least number of children were found in Maharashtra (1.4). The number of children is one of the indicators of poverty in terms of distribution and use of resources. Most of the households do not own land for cultivation except 33% of households in the category of TGP work type. These communities, which were mostly in Uttarakhand (90% of households) work with pack animals in nearby sites compared to migrating to find work because they own land. They mostly use mules for the transport of goods in pilgrimage sites, and they work in the land when there is no seasonal work.

The study found most of the breeding, brick kiln cart and brick kiln pack work type households belong to the Scheduled Castes 98%, 99%, and 70%, respectively. Among Rajasthan households, the dominant work types of donkeys with carts belong to the Backward class at more than 60% belongs to Muslim community (62%). Literacy levels are lower in communities that own donkeys and mules. Primary school-level education was the most common (70%) in households of Uttarakhand pack animal owners (who also own mules and it was also the highest literacy level (40%) among owners of mules and brick kiln carts owners.

Table 5. Household characteristics of equine owning communities according to work type

Variable	Breeding	BKC	BKP	TGC	TGP
HH size (adult male)	2.2	2.0	2.0	1.6	1.6
HH head age (years)	41	36	41	37	40
Couple (%)	93	86	95	96	91
Single male (%)	2	14	5	4	4
Single female (%)	5	1	0	0	4
No of children (average)	2.9	2.2	2.6	2.3	1.7
Land owned (%)	0	14	11	1	33
Caste-Forward class (FC)- %	0	0	0.8	1	16.3
Caste-Backward class (BC)-%	0	0	28.1	63.8	28
Caste-Scheduled Caste (SC)-%	98.3	99.1	70	34.3	54.9
Caste-Scheduled Tribe (ST)-%	1.7	0.9	1.2	1	0.8
Religion-Hindu (%)	100	99	99	38	100
Religion-Muslim (%)	0	1	0	62	0
Education-Illiterate (%)	81	45	60	70	30
Education-Literate (%)	19	55	40	30	70

Livestock ownership

Households that work with the pack animal type of activity in the brick kiln or markets have a higher number of working equines such as brick kiln pack (BKP) (8.1) and TGP (6.4) which require more animals to carry loads than cart type of work. Pack-type working households own mostly donkeys than cart-type working households that own mostly mules (Table 6). Mules are used for both pack and cart types of work. However, donkeys are used only in the pack type of work except in Rajasthan where donkeys are used in cart types of work for the transport of goods to market and rural areas, these animals are suitable in the arid region where feed materials are scarce. Households involved with breeding are called qalandars (Nomad Tribes). They own other livestock including cattle, sheep, goats and chickens. In Uttarakhand, more than 50% of households own cattle, buffalo or goats.

Table 6. Livestock ownership among equine owning communities

Variable	Breeding	BKC	BKP	TGC	TGP
Total equines (average)	6.5	1.4	8.1	1.1	6.4
Number of donkeys (average)	1.6	0	6.9	0.5	5.2
Number of mules (average)	3.9	1.1	0.7	1.0	0.6
Households own only donkeys (%)	1.5	0	37.7	21.9	38.9
Households own only mules (%)	2.9	30.4	6.7	31.1	27.9
Livestock units (LU except for equine)	2.1	0.8	0.4	0.2	0.6

Food availability and diet diversity

August, September, and October were reported by brick kiln working type households as the most food insecure in the year. The food shortages in these months can be explained by the rainy season when these owners do not work in brick kilns for their livelihood. More than 60% of households that own pack animals in brick kilns and other regions have experienced food insecurity in any one month of the year. Breeding-type animal-owning communities experienced more food insecurity than other work types (91%). Pack animals work type households (BKP and TGP) and cart animals type households from Rajasthan (TGC) experienced the highest lean and worst months of food insecurity than other work types (>4 months). Food diversity was less among cart-type working animals and breeding animal-owning households (Table 7). These households also experienced more hunger months than other households. Households that own pack animals ate more often, the animal-source foods including milk, eggs and meat than other work types.

Table 7. Food availability and diet diversity among different work types of donkey and mule-owning households

Variable	Breeding		BKC		BKP		TGC		TGP	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Lean months diet	2.2	1.5	3.2	1.1	4.1	1.4	4.8	1.6	4.3	1.8
Worst months diet	2.7	1.3	3.2	1.2	3.9	1.2	4.7	1.6	4.2	1.7
Best months diet	3.0	1.2	3.4	1.5	5.1	1.7	5.3	1.6	4.6	1.1
Diet diversity score	3.9	1.4	3.8	1.7	4.9	2.2	3.4	1.2	5.6	1.8
Hunger experience month	4.2	1.2	1.2	1.3	1.5	1.5	2.6	1.2	0.8	0.9
Meat, milk, and egg eaten 24 hours	0.8	0.6	0.8	0.7	1.4	1.0	0.9	0.4	1.6	0.8
Food insecurity reported (% HHs)	91		68		66		43		56	
Total households	58		111		260		207		257	

Living conditions of communities

Households that work in brick kilns have low living conditions like few rooms in the house (1.5-1.7), only 53% of households of brick kiln pack and 62% of households that have cart work type in the brick kiln have electricity in their homes (Table 8). Most of the households do not have a stable for keeping their donkeys and mules and only 36% of households that have carts and work in rural areas have stables (animal shelters) in their home. Households that work in brick kilns mostly lack access to LPG gas for cooking (only 15% have access to LPG for cooking). Most households of all work types have electricity connections and only 68% of brick kiln cart working households have electricity.

Table 8. Living conditions of donkey and mule-owning communities

Work type	Breeding	BKC	BKP	TGC	TGP
Number of rooms mean (SD)	2.2 (2.4)	1.6 (1.1)	1.7 (1.0)	1.5 (0.8)	2.6 (1.9)
Presence of toilets (% hh)	93	62	53	82	72
Stable for animals (% hh)	2	15	15	36	24
Use LPG for the cooking source (% hh)	19	25	20	75	69
Electricity in a home (% hh)	100	68	90	97	97
% HH have BPL card	91	49	54	28	48

Constraints related to working equines

Equine feeding management

High energy feeds like bran, concentrate grains and supplements like jaggery are important for working equines to enable them perform at their best. This study found that only 31% of households offer concentrate grain feed, 18% only offer bran and just 10% of households offer supplements like jaggery to their working animals (Table 9). Good-quality and balanced feed are important for animal performance and health. The study found that households that have pack animals were not offering enough energy feed to their animals. Those farmers who keep animals for breeding (the qalandars) graze their animals outside for more than eight hours and do not feed them much bran or concentrate or supplements. Overall, the communities that own donkeys and mules are below the poverty line and concentrate on their food security than the feed for their animals.

Table 9. Feeding management of working equines of different work-type households

Details of feed management	Breeding	BKC	BKP	TGC	TGP	Total
Offer green fodder (% hhs)	6.9	55.0	30.8	42.0	66.9	45.3
Offer bran (% hhs)	1.7	20.7	28.1	24.6	8.2	18.8
Offer concentrate grain feed (% hhs)	0.0	34.2	9.2	76.8	21.8	31.2
Offer supplements (jaggery/salt etc.) % hhs	0.0	31.5	11.5	7.7	1.6	9.5
Grazing hours/ day	8.3	4.4	5.9	1.9	5.4	4.8

Healthcare management

Colic is the most important healthcare issue in working equines. Lack of quality feed and erratic feeding patterns lead to colic in working equines. This study found a greater number of colic and critical illness cases in pack animals and donkeys than in cart animals (Table 10). Pack animals do more work and carry loads above permissible levels leading to weakness and are prone to illness. Road accidents were reported more among pack animals, whereas surra incidences were reported higher in brick kilns. Animals that work in brick kilns are often tethered to graze in open areas close to ponds and the animals are prone to bites from flies that spread trypanosomiasis.

Table 10. Disease and illness reported by working equine-owning households in 12 months

Diseases/illnesses reported	Breeding	BKC	BKP	TGC	TGP	Total
Colic	28	83	141	151	174	579
Critical illness	14	9	68	43	47	182
Injury/ fracture	3	3	7	3	7	23
Road accident	5	5	16	5	29	61
Trypanosomiasis (surra)	7	10	21	1	0	40

Relationship between food availability in households and income from equines

Households with pack animals work type were found to have higher gross income than the other work types of equines. For example, rural pack animal-owning households' gross income was INR 122,588 followed by brick kiln pack work

type households with INR 116,905 per annum. Brick kiln cart work type households were found to earn much less at INR 64,676/annum. The brick kiln used to have seasonal work types. Qalandar communities that are involved in breeding activities had the least gross income of INR 24,500/annum. An average of 78% of income is earned from equine-related livelihood activities in which more than 80% of income is achieved from equines in TGP, TGC and BKP work types (Table 11). While analyzing how much income from equine work is spent on food, rural households that work in pack or cart work type spent more than 40% of their equine income on the purchase of food items which indicates the poverty level. Statistical analysis of work type, gross equine income and food insecurity are significantly correlated ($P < 0.0001$). Breeding work-type households (Uttar Pradesh) and donkeys working in carts (Rajasthan) have more income and are largely food secure.

Table 11 Income details from equine-based livelihood and their expenditure pattern in different work types of households

Work type of households	Gross Income		% Income from equine		% Income spent on food	
	Mean	SD	Mean	SD	Mean	SD
Breeding	24500	84760	44	19	24	8
Brick kiln cart (BKC)	64577	33670	49	13	29	4
Brick kiln pack (BKP)	116906	94894	81	92	35	11
Transport goods cart (TGC)	87630	30733	89	19	46	11
Transport goods pack (TGP)	123589	82756	88	16	40	11

Recommendations for future interventions from stakeholder meetings

The details of the discussions from the national and state-level stakeholder meetings are given in Table 12-16. These include issues discussed and the stakeholder's recommendations for future interventions. The data from RHoMIS were analyzed for each state and presented in each state stakeholder meeting to discuss issues pertaining to the states.

Table 12. Findings from national stakeholder meeting in New Delhi

Region	Key points/issues discussed	Recommendations	Possible projects	Potential partners
New Delhi national stakeholder meeting	Lack of baseline data for working equines and the communities that own them. ILRI has conducted a baseline survey only for 6 states	The baseline study should be extended to other states with working equines population including horses.	Baseline socio-economic assessment (RHoMIS tool) to cover the other regions in India	ICAR, ILRI, The Donkey Sanctuary (TDS), The Brooke
	Difficult to track the equines during disease outbreaks due to migration patterns	Digital database required to monitor equine population trends, disease surveillance and migration in India	Establishing digital identification of working equines	ICAR, ILRI, GMax, NITARA (Startup digital app company), TDS, The Brooke
	Decline in the donkey population is a big concern. One of the key reasons is the lack of benefit schemes (e.g. health care during natural calamities and disease outbreaks)	Donkey-owning communities to be included in subsidies and food security programs	Advocacy program to bring policy-level interventions to include donkeys in National Livestock Development Schemes	ICAR, ILRI, NRCE, Animal Husbandry Department, Ministry of Animal Husbandry, TDS, The Brooke

Region	Key points/issues discussed	Recommendations	Possible projects	Potential partners
	Emerging trends to establish donkey farms for milk. Lack of guidelines and standard operating procedures (SOPs) for donkey farming will affect the welfare of donkeys	Establishment of a National Donkey Production Program (NDPP) for the welfare of donkeys	Developing guidelines for the donkey milk value chain	ICAR-NRCE, ILRI, FSSAI, TDS
	Lack of safety and standards for donkey milk even though it has high nutritive and therapeutic values	Certification of donkey milk for human consumption Medicinal and cosmetic properties of donkey milk be fully utilized through donkey milk value chain analysis	Milk assessment for food safety issues	FSSAI, ICAR, NRCE, NDDB, NDRI
	Donkey milk value chain is emerging but only private elites benefit	Cooperative structures can be established for donkey milk producers/dependent communities for alternate livelihoods	Establish a cooperative structure for donkey milk producers (donkey owners and entrepreneurs)	Dairy entrepreneurs, ICAR, NRCE, ILRI, NDDB, NDRI

Table 13. Findings from stakeholder meeting in Uttarakhand

Region	Key points/issues discussed	Recommendations	Potential projects	Potential partners
Uttarakhand state stakeholder meeting at Dehradun	Mules are the lifeline for the pilgrimage sites and Uttarakhand in general. Decline in the mule and donkey population is a serious concern as it will affect the welfare of existing equines working in the pilgrimage sites due to increased workload and growing pilgrimage	Mule breeding centres are important to address the declining population and to manage the growing pilgrimage in Uttarakhand which can be taken up under the National livestock Mission (NLM) scheme and public-private partnership (PPP) models	Establish mule breeding centres through state government and PPP models	ICAR, NRCE, state AH Department, ILRI, The Donkey Sanctuary, The Brooke and private entrepreneurs (Start-ups)
	Difficult to track the equines during disease surveillance and monitor their welfare during the pilgrimage season	RFID tags should be made compulsory for the working equines employed in the pilgrim sites	Establish digitalized identification and monitoring system in the pilgrimage sites	ICAR, ILRI, GMax, NITARA (start-up), State AH Department, TDS, The Brooke
	Lack of good-quality feed is the reason for colic and poor body condition score among the equines	Good-quality equine feed should be made available by establishing various feed outlets in all the districts in Uttarakhand	Establish equine feed centres to ensure good-quality nutrition for the working equines	State Animal Husbandry Department, AH Secretary, Animal Welfare Board, ICAR, ILRI, TDS, The Brooke
	Lack of infrastructure, guidelines and regulations is affecting the welfare of equines and pilgrims in the pilgrimage sites	Uttarakhand will study in detail the digitalization of entry and monitoring of animals and pilgrims (Tirupathi temple model)	Establish digitalized identification and monitoring system in the pilgrimage sites	ICAR, ILRI, GMax, NITARA (start-up), state AH Department, TDS, The Brooke

Table 14. Findings from stakeholder meeting in Uttar Pradesh

Region	Key points/issues discussed	Recommendations	Possible projects	Potential partners
Uttar Pradesh state stakeholder meeting at Lucknow	Research findings showed the low-income status of the equine owners in the districts surveyed in UP	Baseline study should be extended to other districts of UP to get an overall situation on the economic status of the equine owners in the state	Baseline socio-economic assessment (RHoMIS tool) to cover the other districts in UP	ICAR, ILRI, state AH Department, The Donkey Sanctuary (TDS), The Brooke
	Difficult to track the equines during disease outbreaks due to migration patterns	Digital database required to monitor equine population trends, disease surveillance and migration	Establishing digital identification of working equines (same as in Uttarakhand)	ICAR, ILRI, GMax, NITARA, TDS, The Brooke
	The migratory nature of work is the main reason for the equine owners working in brick kilns not receiving the below poverty line (BPL) card	Smart card should be issued to the equine owners to ensure subsidized food distribution is available anywhere in the state	Inclusive food distribution system (smart card) for donkey and mule-owning communities	ICAR, ILRI, state AH Department, concerned ministry, TDS, The Brooke
	Only the Qalandar community in UP is involved in breeding for mule production however there is no support to enhance the breeding strategies leads to a decline in the population	To support Qalandar communities through breed enhance programs	Community-based breeding strategies for mule production	Qalandar community, Tate Livestock Development Board, NRCE, ILRI, TDS, The Brooke

Table 15. Findings of stakeholder meeting in Rajasthan

Region	Key points/issues discussed	Recommendations	Possible projects	Potential partners
Rajasthan state stakeholder meeting at Bikaner	Compared to all the states the income from equine work is less in Rajasthan	Alternate livelihood of the poor communities that own donkeys and camels	Enhancing the livelihood of communities that own working animals through the integrated farming system and capacity building for income generation	State AH Department, NRCE, ICAR, ILRI, TDS, The Brooke
	Poor cart designs and harness leads to lameness and injuries	Develop an innovative cart design specific for donkeys	Innovative cart design to reduce the load on working donkeys	University students (start-up), TDS, ILRI
	Lack of regulations and SOPs may affect the welfare of donkeys in the emerging donkey farming	SOPs for donkey farming key for emerging new farms for donkey milk production to ensure the welfare of animals		ICAR, NRCE, ILRI, TDS, The Brooke,
	Understanding economics is vital for research on milk and milk products	Economic assessment of non-bovine milk to be carried out	Techno-economic assessment of donkey milk production	NRCE, ILRI, NRCC, CSWRI, IRMA

Table 16. Findings of stakeholder meeting in Maharashtra

Region	Key points/issues discussed	Recommendations	Possible projects	Potential Partner
Maharashtra state stakeholder meeting at Bikaner	Difficult to track donkeys during a disease outbreak, migration after equine fairs and for insurance schemes	Digital database is required to monitor donkey population trends, disease surveillance and migration	Establishing digital identification of working equines (same as in Uttarakhand)	ICAR, ILRI, GMax, NITARA, TDS, The Brooke, Animal Rahat
	Declining donkey population in Maharashtra	Alternate livelihood options for donkey-owning communities	Integrated farming system and alternate skill development for women for increasing income	NGOs and The Brooke and TDS

Conclusion and recommendations

India's donkey and mule population is alarmingly decreasing. According to the results of the last two livestock censuses (2012-2019) the donkey population declined nationally by 71% and mule population by 64%. This scoping study assessed the status of the donkey and mules and the communities that depend on them in the country. The study's findings were shared with key stakeholders at the national and state levels including policymakers to explore and propose ways of conserving the donkey in the country. Communities that depend on these animals for livelihood were found to be the most marginalized in India, have little bargaining power, and make little and unreliable income from the work animals. The study's assessment of the work types of the equines found that feeding and health care for these animals is inadequate. The education level of household members and the number of children within households that keep them were also found to be low and many of these communities face significant food insecurity due to seasonal work type and their low bargaining power.

At the national level, working equines are neglected and there are few schemes or policies that target their welfare or that of equine-owning communities. This study has given baseline data of donkey-owning communities and their living conditions, economic details, and food security aspects. There was deeper discussion at the state and district levels on the conditions of working equines and their dependent communities. This baseline data for six states and different work types can be used for monitoring indicators for future interventions on equines welfare. The main recommendations from this study are as follows in order of priority.

- Carry out a baseline socio-economic assessment (using the RHoMIS tool) on equines in other regions of India.
- Establish an advocacy program to bring policy-level interventions to include donkeys in National Livestock Development Schemes.
- Establish digitalized identification and monitoring system in the pilgrimage sites to achieve animal welfare and disease surveillance.
- Improving the health delivery system for the donkeys employed in brick kilns and riverbed mining work.
- Reduce the incidence of colic by establishing balanced nutrition for working donkeys and promote women-based entrepreneurship/cooperative for good-quality feed outlets in the brick kilns zones.
- Roll out an inclusive food distribution system (using smart cards) and education for donkey and mule-owning migrant communities.
- Develop guidelines for the donkey milk value chain, food safety assessment, techno-economic assessment and cooperatives for donkey milk producers and entrepreneurs.
- Establish mule breeding strategies and promote private and community-based breeding centres for mule production.
- Enhance the livelihoods of communities that own working animals through the integrated farming system and capacity building for income generation.

- Develop balanced nutrition for working equines and promote entrepreneurship for good-quality feed outlets in the pilgrimage sites.
- Design carts that reduce the load on working donkeys.

Limitations and constraints

The study started in February 2020 with a stakeholder meeting in Maharashtra, but the COVID-19 outbreak in May 2020 delayed further activities of the project. There was a break of more than a year, then the project started again. Due to constraints in budget and limited time, the stakeholder meeting was organized only in 4 states instead of 6 states. However, the remaining stakeholders from these states were called for a central meeting to discuss issues in their states. In the RHoMIS survey format, few variables were dropped due to the prolonged time in the interview which created a loss of information needed for the study.

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Annexes

Annex 1: Review paper

https://drive.google.com/file/d/1GM1ux-ME5wMHq97wb9EVfP-En0_QDTCb/view?usp=sharing

Annex 2: Stakeholder meeting (central and all 4 states) minutes

https://drive.google.com/drive/folders/1zwwDD-XFqUuquhqK1RYuWB971jglhijH?usp=share_link

Annex 3: PPT presented central stakeholder meeting on findings of RHoMIS

https://drive.google.com/drive/folders/1Vfx840umBYZ53Oef7h9N1T1JfXynHnLY?usp=share_link

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