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Origin, history, and current situation of donkeys and mules in Mexico

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ABSTRACT

Objective: To review the economic and social importance of donkeys and mules and their current situation in Mexico.

Design/Methodology/Approach: Donkeys and mules have contributed to human development for thousands of years, mainly as pack animals, helping in the development of trade and the transportation of people. These strong, hardy, and long-lived animals can easily adapt to different environmental conditions, are resistant to diseases, and tolerate heavier loads than horses.

Study Limitations/Implications: These animals are mainly found in developing countries, where they are used for transportation, as beasts of burden, and for agricultural work. Unfortunately, their welfare is threatened as their basic needs (*e.g.*, feeding, health, and housing) are not met, despite their undeniable usefulness, especially in rural conditions.

Findings/Conclusions: Donkeys and mules have played a major role and made an undeniable contribution to human civilizations. Currently, they mainly support people in developing countries, helping them carry out their daily chores and earn income.

Keywords: Donkeys, mules, economic and social importance.

INTRODUCTION

Donkeys and mules are species that have been an important part of people's lives for thousands of years (Kimura *et al.*, 2013). They have great social, economic, and cultural value in the poorest communities worldwide, because they help to improve people's quality of life (Norris, 2021). These animals are of great help to the elderly, women, and children (Davis, 2019). They have a stoic nature and can survive in difficult regions, because their digestive system allows them to optimize poor quality fibrous feeds. Consequently, they are ideally suited for working in areas with extreme climates (Smith, 2016), especially donkeys,

due to their smaller size, ease of handling, and ability to work in small spaces (Queiroz *et al.*, 2021). However, they are not considered am economically transcendental species, unlike other species which generate products for direct consumption (Norris *et al.*, 2021), including meat, milk, and offspring.

The global donkey and mule population is estimated at around 50 million (FAO, 2021). Currently the demand of both donkeys and mules for recreational purposes and agricultural activities is increasing, while donkeys are used for the production of mules, milk, and skin. Both species are appreciated for their great intelligence, security, and work sturdiness (Smith, 2016).

The origin of donkeys and their participation in the development of humanity

The domestic donkey is a direct descendant of the African wild donkey and has two maternal origins, the Nubian donkey (*Equus africanus africanus*) and the Somali donkey (*Equus asinus somaliensis*) (Seyiti and Kelimu, 2021). There is still controversy regarding the place or places where domestication occurred, given that the origins and dates remain uncertain (Rosenbom *et al.*, 2015). However, evidence in murals and fossil remains indicate that donkeys were first domesticated in northern Egypt, where they were used to produce meat and milk (Mayers, 2017). Nevertheless, further work is still necessary on the DNA analysis of the remains found in these places, before a precise place and date of their domestication can be established (Mitchell, 2018).

Seyiti and Kelimu (2021) have theorized that the donkey was domesticated approximately 5,000 years ago by African cattle herders. As a domestic animal, it played an important role in the development and expansion of human civilization, especially in trade (Camillo *et al.*, 2018; McLean *et al.*, 2019). The resulting economic growth (Ali *et al.*, 2015) has influenced the culture of these societies (Seyiti and Kelimu, 2021). Its domestication caused a notable change in the transportation systems of both Africa and Asia, which increased the mobilization of people and goods. They also influenced the organization of the first cities and societies, mainly those that consisted of cattle herders (Rosenbom *et al.*, 2015). Over time and, as a result of the arrival of mechanization, there has been a considerable decrease in the donkey population worldwide (Kugler *et al.*, 2008). Nevertheless, they have never stopped playing an important role in developing countries, where they participate in traction, burden-carrying, and transporting activities, therefore contributing to the subsistence of millions of people (Camillo *et al.*, 2018).

Donkeys are known to be docile animals, regardless of their size: they range from miniature donkeys (<0.90 m) to mammoths and Andalusians, which can reach a height of 1.60 m (Geor, 2013; Smith, 2016). Nowadays, donkeys come in different sizes and have diverse coat textures and colors, with gray, brown, black, roan, white, and their combinations being the most common shades (Mayers, 2017).

Donkey breeds

The diversity of breeds is the result of the various crosses that took place over 2,000 years ago in their journeys along the trade routes that made up the Silk Road (Mayers,

2017). According to FAO (2021) and Norris *et al.* (2021), approximately 163 breeds of donkeys are distributed throughout the world. China has the greatest diversity, with a total of 21 breeds, while Europe is estimated to be home to 17 breeds (The Donkey Sanctuary, 2019), most of which are found in Italy, France, and Spain. Five other breeds are found in Ethiopia, India, Iran, Mali, and Sudan. On the Americas, Venezuela is the country with the greatest number of breeds (6), followed by Brazil and Bolivia (3 each) and Cuba and El Salvador (2 each).

Although the FAO (2021) only reports one native breed in Mexico, there is already a recently created 100% Mexican breed which consequently does not appear in the organization's statistics: the Mixtec donkey. This breed was created by the Asociación Nacional de Criadores de Burros y Mulas, in collaboration with the Universidad de Chihuahua, and was officially presented in 2021 (Panorama Agropecuario, 2021).

The donkey in the Americas

The arrival of the donkey to the American continent is attributed to Christopher Columbus, who asked the kings of Spain for permission to take donkeys during his second voyage (1494), in which he reached modern day Puerto Rico and Cuba. The conquistadores who followed Colón were responsible for taking donkeys to South and Central America and soon the donkey population in the region increased (Smith, 2016). In 1531, 14 donkeys were aboard the ships that sailed from Sevilla to Nueva España, in order to begin mule breeding, which soon became a large-scale activity (Australia, 2019).

Donkeys in Mexico

The first donkeys in Mexico were brought from Arizona by Juan de Oñate in 1598, with the purpose of using them in exploration activities and as draught animals in mining. Once the mining peak ended, donkeys were despised and abandoned in the deserts and wild donkeys are still found in the western United States (Smith, 2016). However, since 1991, the number of donkeys began to decrease drastically and they have even been declared endangered (National Geographic, 2022).

Nevertheless, several non-governmental organizations in Mexico are working on the rescue, protection, and production of donkeys. Burrolandia, located in the municipality of Otumba, State of Mexico, is home to donkeys rescued from abuse. For its part, Granja la Esperanza, a sanctuary located in the municipality of Españita, Tlaxcala, focuses on the production of dairy donkeys, with the ultimate objective of creating a dairy breed and increasing the donkey population. Another example is the Asociación Nacional de Criadores de Mulas y Burros, which has taken on the task of promoting the production of both mules and donkeys (México Desconocido, 2020; González, 2021).

Donkeys are mostly found in poorly developed rural areas and are considered a means of livelihood for many families (Alvarado-Arellano *et al.*, 2011). They are used as beasts of burden and for transportation and draught agricultural activities and they can even be easily handled by children (Tadich *et al.*, 2016). Most donkeys in the country lack good management and they received poor medical care in comparison with horses. Donkey livestock is found throughout the national territory and the largest population

Table 1. Major donkey breeds in the world nowadays.

Raza	Descripción
Abisinio	Conocido también como burro etíope, animal de carga en comunidades pobres de Etiopía.
Bourbonnais	Raza originaria de Francia. Los machos alcanzan una altura máxima de 1.35 m y las hembras 1.28 m, el color representativo es marrón chocolate, con capas grisáceas en la parte del hocico y vientre, las extremidades pueden presentar rayas de cebra.
Cotentín	Raza de la región de Normandía en el noreste de Francia.
Andaluz ó cordobés	Nativo de la provincia de Córdoba en Andalucía, España. Considerada la raza más antigua con 3000 años de existencia. Una altura máxima de 1.6 m, el color predominante es el gris, en ocasiones blanco, de pelo muy fino y suave. Es un animal fuerte y robusto, muy dócil .
Normando	Nativo del noreste de Francia, la raza más pequeña de Francia, una alzada máxima de 1.25 m, utilizada en deportes, turismo y recreación. .
Marroquí o *Raçca Asenca Balear*	Nativo de la costa este de España, con mayor presencia en Mallorca y Menorca, en 2007 fue declarada en peligro de extinción.
Burro de las Encartaciones	Nativo de España, hoy se encuentra en peligro de extinción. Única raza pequeña en España con una altura máxima de 1.2 m y un peso aproximado de 200 kg, capa de color negro, vientre, hocico y bordes de los ojos de color pálido. Su carne era considerada un manjar por lo que eran sacrificados a los tres meses de edad.
Burro de Poitou o Poitevin	Raza originaria de Francia, es de las razas más grandes por lo que se utiliza en la producción de mulares de trabajo.
Burro corso	Nativo de la isla mediterránea de Córcega en Francia. Es una raza pequeña y generalmente gris. actualmente se estima una población de únicamente 1000 ejemplares.
Miranda	Nativa del noreste de Portugal, tiene una altura máxima de 1.35 m, presenta orejas largas con abundante pelo, cascos grandes, extremidades grandes y fuertes, musculosos, cuello y espalda fuertes. Es la única raza reconocida en Portugal, se distingue de otras razas por su pelo que es más largo.
Burro Negro de Berry	De origen francés. Su altura va de 1.35 a 1.45 m y las hembras el tamaño mínimo es de 1.3 m, es de color negro, parte inferior del hocico y vientre son de color gris.
Razas norteamericanas	Las sociedades de cría de Canadá y Estados Unidos no registran como razas a los burros, son descritas como burros miniatura, estándar y grandes. Se trata de los animales descendientes de los traídos por Cristóbal Colón y que se extendieron de México a Estados Unidos y Canadá. Constituyen el 0.1% de la población mundial de burros.
Provenza	Raza de origen francés, los machos alcanzan una altura de 1.20 a 1.35 m y las hembras de 1.17 a 1.30 m, su color característico es gris paloma que puede variar de pálido a oscuro con tonos rosados.
Burro de los Pirineos	De origen francés, los machos miden de 1.25 a 1.35 m de alzada, las hembras de 1.20 a 1.35 m, el color del pelo puede ser negro brillante, castaño o parcialmente negro. Las hembras pueden ser utilizadas para la producción de leche.
Zamorano-Leonés	Raza española, es una raza de talla grande los machos miden hasta 1.45 m y pesan 370 kg. Son de pelo largo y abundante de color negro o laurel oscuro; vientre, hocico y borde de los ojos de color pálido.
Mamut	Raza norteamericana, descendiente de burros grandes importados desde 1785, usado para la cría de mulas de trabajo. Las razas que participaron en la creación de esta raza fueron el Maltes, Poitou, Andaluz, Mallorquín y Catalán. Los machos alcanzan una altura de 1.42 m y las hembras 1.32 m. Cualquier burro americano que supere estas alturas es inscrito en el Registro Americano de burro Mamut Americano. El burro Mamut Americano más grande registrado ha medido 1.73 m.
Amiatina o Italiano	Burro de la toscana del centro de Italia, es de tamaño medio o estándar la altura máxima que alcanzan es de 1.40 m, el pelaje es de color gris ratón, rayas de cebra en las extremidades. Es una raza fuerte y rustica, ideal para terrenos difíciles.
Asinara	Nativo de Italia, es una raza salvaje, la mayoría de la población es total o parcialmente albina.

Source: https://variedadess.net/razas-de-burros/ (2021). Consulted online 10/10/2021

lives in the center of the country. Meanwhile, wild donkey populations are concentrated in northwestern México, in the states of Durango, Chihuahua, Coahuila, and Sonora (Álvarez-Romero and Medellín, 2005). Worldwide research about their behavior and proper management in production systems (where they are used for different jobs) is still scarce (Velásquez Mosquera *et al.*, 2019; Lagos *et al.*, 2021).

Nowadays, donkeys have become popular in tourist activities known as animal tourism. In the case of Tijuana, Baja California, the celebration of the burro cebra ("zebra donkey") has been held for more than 100 years. Donkeys are painted with stripes to imitate the fur of a zebra during this celebration, which has been recognized as a state heritage since 2014. In the State of Mexico, the Feria Nacional del Burro is held in the municipality of Otumba, in the month of April. The population recognizes this fair as an important cultural affair. The three activities that involve the participation of donkeys are the costumed donkey parade, a donkey race, and polo games. Both states benefit economically, socially, and culturally from these festivities (Quintero-Venegas and Rosales-Estrada, 2020).

The Mexican donkey is remarkable hardy, managing to carry a load of up to 80 kg on its back and pull up to 350 kg. This hardiness is the result of the lack of genetic selection, which has allowed it to maintain its rusticity and consequently to withstand adverse conditions and to survive making the most of the poor-quality forage. All these characteristics makes it a very efficient animal (Pérez, 2019; González, 2021).

General aspects of mules and their arrival to Mexico

Originally the term "mule" was used to name any descendant of two different types of equids (Pascual-Barea, 2016). The first mules were bred in the north and northeast of modern-day Turkey. Known as the oldest human-made hybrid, they originally resulted from the crossing of wild donkeys and mares that shared the same territory (Dave, 2021). Mules are highly versatile and independent animals, like donkeys and unlike horses. They are 1.52 to 1.77 m tall and weigh from 300 to 680 kg. They are long-lived animals, whose life expectancy is 35 to 40 years (Davis, 2019; Dean, 2021). Their characteristics are highly appreciated: thousands of years ago, they were preferred over horses as beasts of burden and for trade activities.

Mules are very efficient hybrid working animals resulting from the cross between a male donkey and a mare (Mosquera *et al.*, 2019). They have a similar height and teeth to horses (Australia, 2019; Dean, 2021). Ninety-nine percent of mules are sterile, as a consequence of their odd number of chromosomes (63). Although, some mules can be crossed with horses or donkeys and their pregnancies can reach their term, their offspring will be weak and sickly. Meanwhile, hinnies are a hybrid resulting from the crossing of a horse with a female donkey (Lozano *et al.*, 2011; Dean, 2021).

Mules arrived to Mexico in the 16th century (Mijares, 2010). In 1495, Christopher Columbus brought donkeys and mares to the "New World" and began breeding mules which the conquistadores used during their expeditions (Dave, 2021). Mules played a major role in the conquest and mining activities. In the 16th century, they were used to transport silver from Mexico City to the port of Veracruz and various goods on both directions of

that route. They were used for their ability to move through inaccessible terrain (Smith, 2016). In the 20th century, the mule became an essential means of transportation for different social strata. Its physical characteristics allowed it to adapt to the conditions of the difficult-to-access terrains of the country. This remarkable animal is of great size and vigor. Its typical short but firm step allows it to travel on any type of road, carrying 115 to 200 kg loads (depending on the size of the animal). They have been used to pull wagons and carts —for example, during the boom of the mining industry in several states, including Zacateas (Mijares, 2010). Consequently, they became the beasts of burden of choice (Australia, 2019).

Mules are important for the development of agricultural sustainability in mountain areas (Velásquez Mosquera *et al.*, 2019). Mules are believed to be usually more aggressive than horses and to hinder work; however, if they are worked with a lot of patience and from an early age, a strong bond can be created between human and animal that increases the confidence and security with which both the animal and the handler work (Davis, 2019). They are very intelligent animals that need to be worked with respect to create trust and thus obtain a friendly response. If their trust is obtained, the strong bond that is created means that mules always seek to protect their handlers.

Mule population in Mexico

Currently the mule population in the Americas is approximately 10 million. Mexico is the country with the highest number of mules with 3,287,994 individuals, followed by Brazil with 751,921.8 and China with 428,700 (FAO, 2021; Norris *et al.*, 2021). Norris *et al.* (2021) reports an ongoing decline in the number of mules: from 1961 to 2007, the world population remained around 10 million, but it has decreased to less than 8 million (7,936,976) from 2007 to 2019. For its part, Mexico reached three million mules in 1969 and, according to the information provided by the FAO, the population remained constant until 2019 (Allan, 2021).

CONCLUSIONS

The outlook for donkeys and mules may seem complicated given the lack of interest in their production. Nevertheless, they are very noble animals with highly varied attitudes and surprising intelligence that today do not receive the attention and recognition they deserve, despite their social and economic importance, especially for low-income populations. There are plenty of opportunities to work with donkeys and mules in the world. A renewed interest in their use for different purposes (*e.g.*, work and recreation) has arisen in Mexico in recent years.

REFERENCES

Ali, A.B.A., El Sayed, M.A., McLean, A.K., Heleski, C.R. 2019. Aggression in working mules and subsequent aggressive treatment by their handlers in Egyptian brick kilns—Cause or effect? *J. Vet. Behav.* 29, 95–101. https://doi.org/10.1016/j.jveb.2018.05.008.

Ali, A.B.A., Matoock, M.Y., Fouad, M.A., Heleski, C.R. 2015. Are mules or donkeys better adapted for Egyptian brick kiln work? (Until we can change the kilns). *J. Vet. Behav.* 10, 158–165. https://doi.org/10.1016/j.jveb.2014.12.003.

Allan,K.F. 2021. A Landscaping analysis of working equid population numers in LMICs, with policy recomendations. https://www.thebrooke.org/sites/default/files/Images/Equid_Population_Landscaping_Analysis.pdf.

Alvarado-Arellano, A., Olmos, G., Burden, F., Herenandéz-Gil, M., du Toit, N. 2011. Descripción de una técnica de necropsias en equinos realizada en campo; utilizando un burro (*Equus asinus*) como modelo para su desarrollo. 6.

Álvarez-Romero, J. y R. A. Medellín. 2005. *Equus asinus*. Vertebrados superiores exóticos en México: diversidad, distribución y efectos potenciales. Instituto de Ecología, Universidad Nacional Autónoma de México. Bases de datos SNIB-CONABIO. Proyecto U020. México. D.F. http://www.conabio.gob.mx/conocimiento/exoticas/fichaexoticas/Equusasinus00.pdf.

Australia, G. 2019. Arrieros de México…de mulas, asnos y burros. Consultado: 02/11/2021. https://vocesmexico.com/voces-tematicas/cultura/arrieros-de-mexico-de-mulas-asnos-y-burros/.

Dave, B. 2021. History of the Mule». American Mule Museum. Consultado en Línea: 28/11/2021.

Davis E. Donkey and Mule Welfare. *Vet Clin North Am Equine Pract*. 2019 Dec;35(3):481-491. doi: 10.1016/j.cveq.2019.08.005. PMID: 31672200.

Dean, E. 2021. Donkey vs Mule: What's the Difference? (With Pictures). Consultado en Línea: 27/11/2021: https://petkeen.com/donkey-vs-mule/.

Food and Agriculture Organization of the United Nations - (FAO). FAOSTAT.2021. Tendencias en la ganadería. Consultado en Línea: 27/11/2021. https://www.fao.org/faostat/es/#data/EK.

Food and Agriculture Organization of the United Nations - (FAO). FAOSTAT. 2021. Consultado 20/11/2021. Disponible en: http://faostat.fao.org.

Geor, R.J. (Ed.) 2013. Equine applied and clinical nutrition: health, welfare and performance. Saunders Elsevier, Oxford.

González, R. 2021. La esperanza busca salvar de la extinción al burro mexicano. Milenio Puebla. Consultado: 02/11/2021. https://www.inforural.com.mx/la-esperanza-busca-salvar-de-la-extincion-al-burro-mexicano/.

Kimura, B., Marshall, F., Beja-Pereira, A., Mulligan, C. 2013. Donkey Domestication. *Afr. Archaeol. Rev.* 30, 83–95. https://doi.org/10.1007/s10437-012-9126-8.

Lagos, J., Rojas, M., Rodrigues, J.B., Tadich, T. 2021. Perceptions and Attitudes towards Mules in a Group of Soldiers. *Animals* 11, 1009. https://doi.org/10.3390/ani11041009.

Mayers, A. 2017. Under the skin. Sidmouth (United Kingdom): The Donkey Sanctuary. pp. 1–17.

McLean, A.K., Navas González, F.J., Canisso, I.F. 2019. Donkey and Mule Behavior. *Vet. Clin. North Am. Equine Pract.* 35, 575–588. https://doi.org/10.1016/j.cveq.2019.08.010.

México desconocido. 2020. Burro mixteco, la nueva raza de burro 1005 mexicana. consultado en línea: 01/11/2021. https://www.mexicodesconocido.com.mx/burro-mixteco-la-nueva-raza-de-burro-100-mexicana.html#:~:text=Hoy%2C%20gracias%20al%20trabajo%20de,ser%20designado%20como%20una%20raza.

México desconocido. 2021. El burro mexicano, un animal en peligro de extinción. Consultado en línea: 01/11/2021. https://www.mexicodesconocido.com.mx/burro-mexicano-un-animal-en-peligro-de-extincion.html.

Mijares, I. 2010. Caminos y mercados de México, 1. ed. ed, Serie Historia general / Instituto de Investigaciones Históricas. Universidad Nacional Autónoma de México : Instituto Nacional de Antropología e Historia, México, D.F.

Mitchell, P. 2018. The Donkey in Human History 337. An Archaelogical perspective. Oxford University Press. Reino Unido. ISBN 978-0-19-874923-3. P. 337

Mosquera, J.C.V., Álvarez, J.D.C., Jacometo, C.B. 2019. Morphofunctional characteristics of working mules in mountain areas of the Colombian Central Andes. *Acta Sci. Anim. Sci.* 42, e46379. https://doi.org/10.4025/actascianimsci.v42i1.46379.

Nathional Geographic. 2022. El burro, una especie en extinción en México. consultado en línea: 09/10/2022 https://www.ngenespanol.com/animales/burro-en-peligro-de-extincion-en-mexico/.

Norris, S.L., Little, H.A., Ryding, J., Raw, Z. 2021. Global donkey and mule populations: Figures and trends. *PLOS ONE* 16, e0247830. https://doi.org/10.1371/journal.pone.0247830.

Panorama Agropecuario. 2021. El Desarrollo del Burro Mixteco. Consultado en línea 02/11/2021. https://www.youtube.com/watch?v=jS3C11KsbQg.

Pascual Barea, Joaquín. 2016. «Notas al pasaje de Isidoro sobre el mulo y otros híbridos y sobre transmisión al feto de imágenes vistas por la madre». En Santamaría Hernández, María Teresa, ed. Traducción y transmisión doctrinal de la Medicina grecolatina desde la Antigüedad hasta el Mundo Moderno:

nuevas aportaciones sobre autores y textos. Colección Escuela de Traductores de Toledo, 17 (Cuenca: Universidad de Castilla-La Mancha): 25-52.

Queiroz, M.R., Gameiro, M.B.P., Zanella, A.J. 2021. The population of donkeys and mules in Brazil according to agricultural censuses from 1960 to 2017. *Braz. J. Vet. Res. Anim. Sci.* 58, e174365. https://doi.org/10.11606/issn.1678-4456.bjvras.2021.174365.

Quintero Venegas, G.J., Rosales Estrada, P.T. 2020. Valoraciones éticas de dos prácticas zooturísticas en México, cuestiones sobre geografia de los animales. *PatryTer* 3, 30–41. https://doi.org/10.26512/patryter.v3i5.27014.

Rosenbom, S., Costa, V., Al-Araimi, N., Kefena, E., Abdel-Moneim, A.S., Abdalla, M.A., Bakhiet, A., Beja-Pereira, A. 2015. Genetic diversity of donkey populations from the putative centers of domestication. *Anim. Genet.* 46, 30–36. https://doi.org/10.1111/age.12256.

Seyiti, S., Kelimu, A. 2021. Donkey Industry in China: Current Aspects, Suggestions and Future Challenges. *J. Equine Vet. Sci.* 102, 103642. https://doi.org/10.1016/j.jevs.2021.103642.

Smith, D.C. 2016. The book of donkeys: a guide to selecting, caring, and training. LP, Guilford, Connecticut.

Tadich, T.A., de Aluja, A., Cagigas, R., Huerta, L.A., Galindo, F. 2016. Los niños reconocen las necesidades de los burros de trabajo, en Tulimán, México: Observaciones preliminares 3, 7.

The Donkey Sanctuary. 2017. About donkeys - breeds and cross-breeds. In: Knowledge and advice. Consultado en línea: 10/11/ 2021. https://www.thedonkeysanctuary.org.uk/ what-we-do/knowledge-and-advice/about-donkeys.

Velásquez Mosquera, J.C., Correa Rojas, I., Corrales Álvarez, J.D. 2019. Saberes tradiciones sobre manejo de mulares en el área central-andina de Colombia. *Rev. Univ. Salle* 1, 263–276. https://doi.org/10.19052/ruls.vol1.iss79.14.