SSAR Journal of Arts Humanities and Social Sciences (SSARJAHSS)

Subject: Arts Humanities and Social Sciences
Journal homepage: https://ssarpublishers.com/sarjahss
Abbreviated Key Title: SSAR J Arts Humanit Soc Sci
ISSN: 3049-0340 (Online)
Volume 2, Issue1, (Jan-Feb) 2025, Page 26–36 (Total PP.11)
Frequency: Bimonthly
E-mail: ssarpublishers@gmail.com

OPEN ACCESS

Donkeys: Unsung Heroes of Agriculture, Health, and Sustainability in a Changing World

By
Corresponding author: Mohamed Aroua, --- E-mail: arouamohamed2310@gmail.com
CO-Author: [2]Samia Ben Said, [3]Mokhtar Mahouachi
University de Jendouba, Ecole Superieure d' Agriculture du Kef, LR: Appui à la Durabilite des Systemes de Production Agricoles du Nord-Ouest, Complexe Universitaire Boulifa, Le Kef 7119, Tunisia

Abstract: Donkeys, often underestimated in comparison to other domesticated animals, play a crucial and multifaceted role in human society. This work aims to explore the socio-economic, therapeutic, and ecological importance of donkeys, with a focus on their contributions in rural and urban areas worldwide. In regions with limited infrastructure, particularly in Africa, Asia, and the Mediterranean, donkeys provide essential labor in agriculture, transportation, and waste management. Additionally, donkey-derived products such as milk, meat, and skin are gaining increasing attention for their health benefits, driving emerging industries in both local and global markets. Donkey milk, prized for its anti-inflammatory and anti-aging properties, has found a place in the beauty and healthcare sectors, while donkey meat and leather serve as valuable resources in certain cultural contexts. Moreover, donkeys contribute to sustainable land management by mitigating soil erosion, promoting plant regeneration, and reducing grazing pressure on fragile ecosystems, particularly in regions affected by climate change. This paper emphasizes the need for ethical and sustainable donkey farming practices to ensure the continued welfare of these animals and their vital role in supporting both human livelihoods and ecological balance.

Keywords: Donkey, Socio-economic importance, Sustainable land management, Milk, Meat

INTRODUCTION

Donkeys, often overlooked in comparison to other domesticated animals like horses or cattle, have played a crucial role in human societies for centuries. Their contributions to agriculture, transport, medicine, and even cultural practices are as diverse as the regions in which they are found. While donkeys are traditionally seen as hardworking, humble animals, their true value extends far beyond their status as beasts of burden. As resilient and adaptable creatures, donkeys have earned their place in both rural and urban landscapes, especially in regions where environmental conditions are harsh, and infrastructure is lacking.

In rural areas, donkeys provide invaluable support to farming communities, often in regions that face geographic challenges such as mountainous terrain or limited access to mechanized farming tools(Mitchell, 2018). Their ability to thrive in environments where other livestock may struggle makes them indispensable for tasks such as plowing fields, transporting goods, fetching water, and aiding in transhumance—the seasonal migration of livestock (M Aroua, Fatica, Ben Said, Mahouachi, & Salimei, 2024). In countries across Africa, Asia, and the Mediterranean, donkeys have been integral to the survival of rural economies, providing critical labor where it is most needed (Camillo et al., 2018; Raw, Collins, & Burden, 2024; Rodrigues, Raw, Santurtun, Cooke, & Clancy, 2021).

In addition to their practical contributions, donkeys are also deeply embedded in cultural and religious traditions (Volsche et al., 2024; Watson et al., 2020). They are revered in many societies for their strength, resilience, and role in sustaining livelihoods. For example, in the Mediterranean region, donkeys have long been a part of agricultural practices and have played a role in preserving the region's unique landscapes and biodiversity (Segarra, Fernàndez-Martínez, & Araus, 2023). Similarly, in African and Middle Eastern cultures, donkeys are often associated with both practical utility and spiritual significance, as they are seen as symbols of humility, endurance, and service (M. Geiger & A. J. Hovorka, 2015; Selove, 2023).

In recent years, there has been a growing recognition of the broader benefits donkeys provide, especially in the context of climate change and sustainability (Geiger et al., 2020a; Haddy, 2022). As the global community faces the challenges of environmental degradation and climate change, donkeys' ability to thrive in harsh, arid, and marginal ecosystems is becoming more relevant. Their capacity to work with minimal resources, including low-quality forage and scarce water, makes them valuable assets for farmers in drought-prone areas (Miraglia, Salimei, & Fantuz, 2020; Rodrigues et al., 2021; Friday Ocheja Zakari, Joseph Olusegun Ayo, Mohammed Umar Kawu, & Ibrahim Rekwot, 2015). Additionally, donkeys contribute significantly to soil health and the regeneration of plant life, playing a role in maintaining ecological balance and mitigating the effects of land degradation (Furtado et al., 2022b).

Moreover, the demand for donkey-derived products—particularly donkey milk, meat, and skin—is rising. Donkey milk, once primarily used for medicinal and nutritional purposes, is now a sought-after commodity in the global beauty and healthcare markets due to its reputed anti-aging, moisturizing, and anti-inflammatory properties (Mohamed Aroua et al., 2023; Mohamed Aroua, Jemmali, Said, Touati, & MAHOUACHI, 2018; Mohamed Aroua, Jemmali, Said, Kbaier, & Mahouachi, 2019). As luxury skincare brands incorporate donkey milk into their products, specialized donkey farms have emerged, catering to a growing consumer demand. Similarly, donkey meat and skin are highly valued in specific regions, contributing to local economies and providing alternative sources of protein and material goods (Mohamed Aroua, Nour Elhouda Fehri, et al., 2024; Mohamed Aroua, Hayet Haj Koubaier, et al., 2024).

Despite their importance, donkeys often face challenges related to overexploitation and poor welfare (M. Geiger & A. Hovorka, 2015), particularly as demand for their products increases. Sustainable breeding practices, ethical treatment, and the responsible management of donkey populations are critical to ensuring that these animals continue to provide value to human societies without compromising their well-being. As interest in donkey products grows, so too does the need for regulations that protect both the animals and the environment they help sustain.

This paper explores the many facets of donkey importance, focusing on their socio-economic, therapeutic, and ecological roles. Through an examination of their contributions to agriculture, their cultural significance, and the emerging markets for donkey products, we aim to highlight the multifaceted value of donkeys. Additionally, this paper emphasizes the need for sustainable breeding and ethical practices to ensure that donkeys continue to thrive and contribute to the well-being of communities around the world.

1. Socio-Economic Importance of Donkeys Around the World

Donkeys have long been a cornerstone of agricultural and rural life, particularly in regions

where access to mechanized farming equipment is limited or economically unfeasible (Binda, 2019). These animals have been a reliable source of labor for centuries, valued for their strength, stamina, and exceptional adaptability to diverse climates and terrain (Haddy, 2022). Their role is especially pronounced in areas that face environmental, geographical, or logistical challenges where other forms of transportation and agriculture are either impractical or unsustainable (Watson et al., 2020).

In many parts of Africa, donkeys are indispensable for performing agricultural labor and supporting rural economies, particularly in countries with underdeveloped infrastructure and limited access to modern technology (Fall, Diack, & Dia, 2003; Jones, Neill, Riches, & Sims, 2005). As many of these regions rely on subsistence farming, donkeys are often the primary draft animals used to plow fields, transport goods, and move water for irrigation. In some cases, donkeys have replaced larger livestock like oxen, which were once the primary draft animals. In Nigeria, for example, the rise in fuel costs has led farmers to increasingly rely on donkeys for transport and agricultural tasks, as donkeys are more cost-effective and require far less maintenance than motorized vehicles in areas where fuel shortages, high maintenance costs, or limited infrastructure hinder the use of machinery, donkeys offer a reliable and efficient alternative(Roger Blench, 2015).

Donkeys' versatility extends beyond just cost-saving and labor; they have the ability to thrive in more rugged and harsh environments. Their hardiness makes them an ideal choice for areas that experience extreme weather conditions or difficult terrain. In regions where cattle would traditionally be used for draft work, donkeys have proven to be just as effective, if not more so. Unlike cattle, donkeys can work in areas with poor-quality forage and difficult terrain, such as mountainous regions and arid zones, where the harsh conditions would prevent other livestock from performing similar tasks (Mota-Rojas et al., 2021; Friday Ocheja Zakari, Joseph Olusegun Ayo, Mohammed Umar Kawu, & Ibrahim Rekwot, 2015). Their ability to carry heavy loads and work in the most challenging of environments makes them indispensable for smallholder farmers who rely on them to transport goods, water, and agricultural products across areas that lack road infrastructure (Grace et al., 2022).

Donkeys are also vital in regions with challenging geographical landscapes, such as mountainous or semi-arid zones, where motorized vehicles are often unable to access (Clancy, Watson, & Raw, 2022). In many parts of Africa and the Middle East, donkeys are relied upon for transporting goods and people over difficult terrain, where roads may be impassable for vehicles. In countries like Burkina Faso, Cameroon, Senegal, and Tunisia, donkeys play a central role in transhumance—the seasonal migration of herders and livestock (Diallo et al., 2021). These migrations often occur in areas where pastures and water sources vary by season, requiring herders to move animals across vast, rugged landscapes (Nori, 2019). Donkeys help facilitate these migrations by carrying supplies and assisting with herding livestock, allowing people to continue their pastoral livelihoods in areas where mechanized transport is impractical.

Urban centers, particularly in older cities with narrow streets like those found in North Africa and the Middle East, also rely on donkeys for waste collection, street cleaning, and transporting goods. In many of these cities, known as medinas, narrow alleyways prevent motorized vehicles from entering, making donkeys the most effective means of transport. Donkeys are used to carry food products from markets, deliver building materials to construction sites, and even collect waste in densely populated areas where access for other forms of transport is limited (Fernando & Starkey, 2004). They are also frequently used in local trades, such as carrying firewood or crops, where their small size and ability to navigate tight spaces make them perfect for these tasks.

Furthermore, the economic importance of donkeys extends beyond their labor. The growing demand for donkey-derived products, such as milk and meat, has become an important source of income for farmers in many regions (M Aroua et al., 2024; Mohamed Aroua, Nour Elhouda Fehri, et al., 2024; Mohamed Aroua, Hayet Haj Koubaier, et al., 2024). Donkey milk, highly valued for its nutritional and therapeutic properties, has gained popularity in global markets, particularly in Europe, where it is used in luxury skincare products due to its anti-aging and moisturizing

effects (Martini, Altomonte, Tricò, Lapenta, & Salari, 2021). In West Africa, donkey meat is a significant source of protein, providing an affordable and nutritious option in regions where other sources of animal protein are limited (Hassan et al., 2022). As the demand for donkey products increases, the role of donkeys in contributing to local economies and food security becomes even more evident.

Overall, donkeys remain a vital part of agricultural and urban life across much of the world, contributing to the daily lives of rural and urban populations alike (Geiger et al., 2020b). Their strength, endurance, and adaptability ensure they continue to play an essential role in a wide range of activities—from agriculture to transportation to waste management. With rising fuel costs, environmental challenges, and the need for sustainable agricultural practices, the importance of donkeys is expected to grow, further solidifying their position as one of the most valuable and versatile animals in human history. As the demand for donkey-derived products continues to rise, these animals are becoming increasingly central to both local economies and global markets, ensuring that they will remain indispensable for generations to come.

2. Promoting Donkey Products: A Growing Industry

As global consumer preferences shift towards more natural, organic, and sustainable products, donkey-derived goods have experienced a notable surge in demand. Historically, donkeys have been valued for their labor, but in recent years, their byproducts—such as milk, meat, and skin—have gained significant attention in niche markets, particularly in the beauty, healthcare, and food industries (Gordon, 2017). These products are becoming increasingly sought after due to their reputed health benefits, versatility, and sustainable production methods. This growing interest in donkey products offers significant economic opportunities for rural communities and has the potential to create new industries, particularly in countries where donkey farming has traditionally been a secondary or supplementary source of income.

Among the most sought-after donkey-derived products, donkey milk stands out for its remarkable health and beauty benefits. Rich in bioactive compounds such as immunoglobulins, lysozyme, lactoferrin, and omega-3 fatty acids, donkey milk has been used for centuries in traditional medicine (M Aroua et al., 2024). Its use dates back to ancient civilizations, where it was valued for its therapeutic effects on skin conditions, respiratory ailments, and overall health. Today, donkey milk is increasingly being recognized as a high-end ingredient in luxury skincare products due to its remarkable moisturizing, healing, and anti-aging properties. It is particularly prized in high-end creams, lotions, soaps, and facial masks.

The milk's anti-inflammatory, antibacterial, and antioxidant properties make it a natural remedy for sensitive or irritated skin. It helps reduce the appearance of fine lines, increases skin elasticity, and provides deep hydration, which is why it has become a popular ingredient in premium skincare formulations. Donkey milk's potential to soothe and repair the skin makes it especially valuable in treating conditions such as eczema, psoriasis, and other dermatological issues (Kazimierska& Kalinowska-Lis, 2021). Furthermore, its gentle nature makes it an ideal solution for individuals with sensitive skin or allergies to more common dairy sources like cow's milk.

In addition to its cosmetic benefits, donkey milk is gaining recognition for its nutritional value. The composition of donkey milk closely resembles that of human breast milk (Mohamed Aroua et al., 2018), which has led to its increasing use as an alternative to cow's milk. Its high levels of lactose, proteins, and fats make it easily digestible, making it particularly beneficial for infants who are unable to consume breast milk. In regions where access to breast milk is limited—such as areas experiencing breastfeeding challenges or regions with low rates of breast milk availability—donkey milk is regarded as an important and highly nutritious alternative. It has been used as a food source for infants and young children, providing essential nutrients for growth and development (Madhusudan et al., 2017).

The growing demand for donkey milk, particularly in European markets like France and Italy, has led to the establishment of specialized donkey farms that cater to this demand. These farms are carefully regulated to ensure the highest

quality of milk production, providing a sustainable source of income for local farmers and stimulating rural economies. As donkey milk is recognized not only for its nutritional and therapeutic properties but also for its environmental sustainability, it has carved out a niche within the broader market for natural and organic products.

Beyond milk, other donkey products have found important uses in both local and global markets. In parts of Asia, especially in China, donkey skins are highly valued for the production of leather goods. Donkey leather is prized for its durability and quality, making it a sought-after material for fashion items such as shoes, bags, and clothing accessories. The demand for high-quality leather products, especially in emerging markets, has contributed to a steady market for donkey skins (Binda, 2019). These leather products are not only considered fashionable but are also valued for their environmental sustainability compared to synthetic materials.

In many parts of Africa, donkey meat is also highly regarded as a rich source of animal protein. In West Africa and parts of Tchad, donkey meat is a popular delicacy, often consumed during celebrations or important social events(Mitchell, 2018). The meat is lean and protein-rich, offering a nutritious alternative to more common meats like beef or goat. For communities where other sources of meat may be scarce or expensive, donkey meat provides an affordable and accessible option. The demand for donkey meat, particularly in countries with large populations of rural farmers or pastoralists, has helped create a more diversified local economy, offering new opportunities for farmers who breed donkeys primarily for milk, meat, or leather production.

As global markets expand and consumer preferences continue to shift towards more sustainable, ethical products, the promotion of donkey-derived products has the potential to generate significant income for rural farmers. By diversifying income streams through donkey farming, communities can reduce their reliance on traditional livestock or crop farming alone. This diversification helps stabilize local economies, especially in regions where other farming practices may face challenges due to environmental changes, climate impacts, or market fluctuations.

The increasing demand for donkey products is not just an opportunity for local farmers but also for the global economy. By creating markets for donkey-derived goods such as milk, meat, and leather, rural communities can tap into high-value, niche markets that support sustainable development and provide alternative income sources. This growing industry has the potential to help revitalize rural economies, particularly in countries with high donkey populations but limited infrastructure. Additionally, as consumer demand for ethical, natural, and organic products continues to rise, donkey farming can be positioned as a sustainable and eco-friendly farming practice.

The expansion of the donkey farming industry can also create new jobs and opportunities for entrepreneurs, ranging from the production of donkey milk and related products to leather goods and meat processing. As demand for these products grows, further innovation in the sector may lead to the development of new applications, such as donkey milk-based nutritional supplements or medicinal products. These innovations can help create more sustainable supply chains and increase the profitability of donkey farming while maintaining animal welfare standards (Jasinski, 2021).

3. Donkeys and Climate Change: A Critical Role in Sustainability

As the effects of climate change continue to intensify, regions across the globe are grappling with more frequent and severe droughts, desertification, and soil erosion. In many of these areas, the ability to maintain productive agricultural systems and healthy ecosystems is becoming increasingly difficult. With their unique resilience and adaptability, donkeys are emerging as a key tool in sustainable land management, especially in environments where other forms of livestock or farming practices would falter. Their capacity to thrive in harsh conditions and contribute to ecological restoration makes them a vital resource in mitigating the effects of climate change (Goulder, 2018).

Donkeys are particularly well-suited for survival in arid, semi-arid, and mountainous regions—environments that are highly vulnerable to climate change (Bulliet, 2024). These animals have

evolved to endure tough conditions, with a remarkable ability to graze on low-quality forage that other animals may find unpalatable (Hlatshwayo, 2023). Their digestive systems are efficient at extracting the nutrients from rough vegetation, allowing them to survive in areas where pasture quality is low, and water is scarce (Martin-Rosset et al., 2015). In contrast to more sensitive livestock, donkeys can function on minimal resources, such as dry grasses, shrubs, and other fibrous plants, making them ideal animals for farming in regions where other livestock would struggle to thrive.

Their minimal water requirements further enhance their ability to adapt to drought-prone environments. While cattle, sheep, and goats need regular access to water and high-quality forage to perform well, donkeys can survive in areas where these resources are not as readily available. This makes donkeys an essential livestock option for farmers facing the increasing unpredictability of water availability due to climate change.

Donkeys' ability to thrive in challenging conditions allows farmers in regions facing desertification or prolonged droughts to maintain their agricultural productivity(IFAD, 2021). By incorporating donkeys into farming systems, pastoralists and smallholder farmers can increase resilience to climate-induced stresses, ensuring that essential agricultural tasks such as transport and plowing continue even when resources are limited.

Donkeys play an essential role in the sustainable management of pastoral systems, particularly in regions where livestock farming is the primary livelihood. By integrating donkeys into mixed-species grazing systems, farmers can diversify their livestock, which reduces the pressure on any single species and promotes more sustainable grazing practices (Swai & Bwanga, 2008). This diversification enables pastoralists to adapt more effectively to changing environmental conditions while better managing their land resources.

One of the significant advantages of using donkeys in pastoral systems is their ability to alleviate grazing pressure on sensitive ecosystems (Segarra et al., 2023). In many areas, overgrazing by cattle or goats can lead to soil erosion, loss of vegetation, and degradation of pasturelands. Donkeys, on the other hand, are less reliant on high-quality grasses and can graze on tougher vegetation, making them less likely to overgraze the land. Their unique grazing habits allow them to coexist more harmoniously with other grazing animals and help reduce strain on pasturelands.

Through careful management of donkey populations, pastoralists can maintain healthy grazing patterns and avoid the negative effects of overgrazing (Gezahegn, 2006). Rotating grazing areas and incorporating donkeys into these rotations give the land time to rest and regenerate, ensuring that pasturelands remain productive and resilient (Dagar & Gupta, 2020). This rotational grazing system helps preserve soil health, reduce erosion, and improve plant diversity, leading to a more sustainable and resilient land-use system. Furthermore, in regions where water and forage resources are limited, this method of grazing management allows farmers to make the most efficient use of available land while minimizing the risk of land degradation.

In agro-pastoral systems, the integration of donkeys into farming practices enhances land productivity in a sustainable and climate-resilient way (Ojango et al., 2023). Donkeys can assist with plowing, transportation, and transhumance, reducing the reliance on mechanized equipment, which is often costly, inefficient, and unsustainable, especially in rural areas(Roger Blench, Chapman, & Slaymaker, 2003). They help with tilling the soil, facilitating crop planting, and transporting water and harvests, all while reducing the environmental impact of farming activities.

Additionally, donkeys contribute to carbon sequestration in soil (Furtado et al., 2022a). Their grazing encourages the growth of new shoots and grasses, which capture and store carbon from the atmosphere. Healthy, regenerating plant life plays a crucial role in mitigating climate change by acting as a carbon sink, and donkeys support this process by promoting plant growth and improving soil structure. This ecological service is especially valuable in areas where soil health has been compromised by deforestation, overgrazing, or other forms of environmental degradation, further emphasizing the importance of donkeys in sustainable land management (Mwinuka, 2021).

4. Donkey's Role and Positive Effects in the Mediterranean Region

The Mediterranean region, characterized by its hot, dry summers and mild, wet winters, presents distinct challenges for agriculture and land management due to its rugged terrain, uneven landscapes, and limited access to modern farming equipment. In this context, donkeys have played a crucial role for centuries(Mitchell, 2018). Their strength, agility, and adaptability make them indispensable partners in agricultural practices. In areas where mechanized machinery struggles with steep slopes and narrow paths, donkeys are essential for tasks like transporting goods, clearing brush, and cultivating crops(Wickham, 2023). Their compact size and surefootedness make them ideal for navigating the rocky, challenging terrains of olive groves and vineyards, where they help maintain productivity by carrying heavy loads. In regions with limited access to motorized equipment, donkeys perform vital labor-intensive tasks, such as transporting harvested crops to processing areas or markets, especially in places with poor road infrastructure(Panel, 2020). Furthermore, donkeys contribute significantly to the ecological health of Mediterranean landscapes by grazing on invasive species, preventing their overgrowth and supporting the regeneration of native plant species (Simberloff, 2013). Their selective grazing helps preserve plant diversity, reduce land degradation, and combat soil erosion, which is a growing concern in areas like Greece, Italy, and Spain. Additionally, donkeys' droppings serve as a natural fertilizer, enriching the soil and enhancing its fertility, which supports plant growth and combats the negative effects of overgrazing and environmental degradation (Pânzaru et al., 2024). By promoting plant regeneration, reducing soil erosion, and supporting biodiversity, donkeys are integral to the region's sustainable land management and resilience, especially as the Mediterranean faces the increasing impacts of climate change.

5. Therapeutic Importance of Donkeys

Donkeys have long been valued for their therapeutic properties, particularly in regions where access to modern healthcare is limited (Gameiro & Quet, 2023). In parts of Africa, the Middle East, and Asia, donkey-derived products, especially donkey milk, have been used in traditional medicine to treat various ailments. Donkey milk, renowned for its rich content of bioactive compounds such as proteins, fats, immunoglobulin, and lactoferrin, has been an essential remedy for conditions like respiratory infections, gastrointestinal issues, and skin ailments (Vincenzetti, Pucciarelli, Polzonetti, & Polidori, 2017). Its therapeutic potential is attributed to its unique composition, providing nourishment and supporting immune health. With a high content of immunoglobulin's, it acts as a natural immune booster, and its low allergenic potential compared to cow's milk makes it suitable for individuals with sensitivities. In areas where medical supplies are scarce, donkey milk has been a crucial resource for treating minor health complaints, and it has even served as a substitute for breast milk in some communities.

In modern healthcare and the cosmetics industry, donkey milk is gaining increasing recognition for its skin-healing properties. Scientific research has validated many of its historical uses, particularly for treating dermatological issues like eczema, psoriasis, acne, and dry skin. Its anti-inflammatory and antibacterial properties make it an effective remedy for irritated or inflamed skin, while its rich moisturizing ability helps restore the skin's natural barrier(M Aroua et al., 2024).

Beyond skincare, donkey milk's therapeutic potential is being studied for chronic health conditions and autoimmune diseases. It has shown promise in boosting the immune system and regulating immune responses, making it a potential treatment for conditions like rheumatoid arthritis, lupus, and other autoimmune diseases. Preliminary research also suggests that donkey milk's immunoglobulin's and lactoferrin may help combat cancer cells by enhancing the body's immune response and providing antioxidant benefits(Khan et al., 2024). Donkey milk's role in promoting health and wellness continues to be explored, highlighting its diverse and growing therapeutic potential.

Conclusion

Donkeys are much more than just animals of burden; they are essential to the socio-economic, cultural, and ecological fabric of many societies around the world. Their resilience, versatility, and adaptability make them indispensable in regions where other livestock or machinery cannot thrive.

As interest in donkey-derived products such as milk, meat, and skin continues to grow, these animals are becoming key players in global industries, supporting local economies and fostering sustainable development. Moreover, their role in climate change mitigation and ecosystem conservation is increasingly recognized, particularly in regions vulnerable to environmental degradation. By promoting the sustainable breeding and ethical use of donkeys, we can ensure that these remarkable animals continue to contribute to both human well-being and environmental sustainability for generations to come.

References

1. Aroua, M., Ben Haj Koubaier, H., Bouacida, S., Ben Saïd, S., Mahouachi, M., & Salimei, E. (2023). Chemical, physicochemical, microbiological, bioactive, and sensory characteristics of cow and donkey milk kefir during storage. *Beverages, 9*(1), 2.
2. Aroua, M., Fatica, A., Ben Said, S., Mahouachi, M., & Salimei, E. (2024). Preserving Mediterranean Donkeys: A Study on Milk Production and Nutritional Benefits. *Animals*.
3. Aroua, M., Fehri, N. E., Ben Said, S., Quattrone, A., Agradi, S., Brecchia, G., . . . Castrica, M. (2024). The use of horse and donkey meat to enhance the quality of the traditional meat product (Kaddid): analysis of physico-chemical traits. *Foods, 13*(18), 2974.
4. Aroua, M., Haj Koubaier, H., Rekik, C., Fatica, A., Ben Said, S., Malek, A., . . . Salimei, E. (2024). Comparative Study of Carcass Characteristics and Meat Quality of Local Mediterranean Donkey Breeds. *Foods, 13*(6), 942.
5. Aroua, M., Jemmali, B., Said, S., Touati, I., & MAHOUACHI, M. (2018). Milk composition Comparison between donkey, goat and cow breeds. *New Sci, 9*, 202-206.
6. Aroua, M., Jemmali, B., Said, S. B., Kbaier, H. B. H., & Mahouachi, M. (2019). Physicochemical properties of North African donkey milk. *Eur J Nutr, 57*(1), 155-166.
7. Binda, K. (2019). A Donkey's worth in South Africa: domestic laborer or export product; socioeconomic impacts of china's skin trade on South African donkey owners.
8. Blench, R. (2015). A history of animal traction in Africa: origins and modern trends. *Cambridge: Kay Williamson Educational Foundation*
9. Blench, R., Chapman, R., & Slaymaker, T. (2003). A study of the role of livestock in Poverty Reduction Strategy Papers (PRSPs).
10. Bulliet, R. (2024). Exploring Animal Energy in the Arid Zone: More Camels, Fewer Wheels.
11. Camillo, F., Rota, A., Biagini, L., Tesi, M., Fanelli, D., & Panzani, D. (2018). The current situation and trend of donkey industry in Europe. *Journal of Equine Veterinary Science, 65*, 44-49.
12. Clancy, C., Watson, T., & Raw, Z. (2022). Resilience and the role of equids in humanitarian crises. *Disasters, 46*(4), 1075-1097.
13. Dagar, J. C., & Gupta, S. R. (2020). Silvopasture options for enhanced biological productivity of degraded pasture/grazing lands: an overview. *Agroforestry for Degraded Landscapes: Recent AdvancesEmerging Challenges-Vol. 2*, 163-227.
14. Diallo, A. A., Souley, M. M., Issa Ibrahim, A., Alassane, A., Issa, R., Gagara, H., . . . Ba Diouf, R. O. (2021). Transboundary spread of equine influenza viruses (H3N8) in West and Central Africa: Molecular characterization of identified viruses during outbreaks in Niger and Senegal, in 2019. *Transboundaryemerging diseases68*(3), 1253-1262.
15. Fall, A., Diack, A., & Dia, F. (2003). The role of work animals in semi-arid West Africa: Current use and their potential for future contributions. In *Working animals in agriculture and transport* (pp. 27-37): Wageningen Academic.
16. Fernando, P., & Starkey, P. (2004). Donkeys and development: socio-economic aspects of donkey use in Africa. *Donkeys, PeopleDevelopment.*, 15.
17. Furtado, T., King, M., Perkins, E., McGowan, C., Chubbock, S., Hannelly, E., . . . Pinchbeck, G. (2022a). An exploration of

environmentally sustainable practices associated with alternative grazing management system use for horses, ponies, donkeys and mules in the UK. *Animals, 12*(2), 151.

18. Furtado, T., King, M., Perkins, E., McGowan, C., Chubbock, S., Hannelly, E., . . . Pinchbeck, G. (2022b). An exploration of environmentally sustainable practices associated with alternative grazing management system use for horses, ponies, donkeys and mules in the UK. *Animals, 12*(2), 151.
19. Gameiro, M. B. P., & Quet, M. (2023). Feral pharmaceuticalization—Biomedical uses of animal life in light of the global donkey hide trade. *BioSocieties, 18*(3), 679-706.
20. Geiger, M., Hockenhull, J., Buller, H., Tefera Engida, G., Getachew, M., Burden, F. A., & Whay, H. R. (2020a). Understanding the attitudes of communities to the social, economic, and cultural importance of working donkeys in rural, peri-urban, and urban areas of Ethiopia. *Frontiers in Veterinary Science, 7*, 60.
21. Geiger, M., Hockenhull, J., Buller, H., Tefera Engida, G., Getachew, M., Burden, F. A., & Whay, H. R. (2020b). Understanding the attitudes of communities to the social, economic, and cultural importance of working donkeys in rural, peri-urban, and urban areas of Ethiopia. *Frontiers in Veterinary Science, 7*, 60.
22. Geiger, M., & Hovorka, A. (2015). Donkeys in development: Welfare assessments and knowledge mobilisation. *Development in Practice, 25*(8), 1091-1104.
23. Geiger, M., & Hovorka, A. J. (2015). Animal performativity: Exploring the lives of donkeys in Botswana. *EnvironmentPlanning D: SocietySpace33*(6), 1098-1117.
24. Gezahegn, A. K. (2006). *Characterization of rangeland resources and dynamics of the pastoral production systems in the Somali region of eastern Ethiopia.* University of the Free State,
25. Gordon, I. (2017). Reproductive technologies in farm animals.
26. Goulder, J. R. (2018). *Modern development studies as a resource for understanding working animal use in later human prehistory: the example of 4th-3rd millennium BC Mesopotamia.* UCL (University College London),
27. Grace, D., Diall, O., Saville, K., Warboys, D., Ward, P., Wild, I., & Perry, B. D. (2022). The global contributions of working equids to sustainable agriculture and livelihoods in agenda 2030. *EcoHealth, 19*(3), 342-353.
28. Haddy, E. C. (2022). *Understanding the role of environmental and human factors in working equid welfare.* University of Portsmouth,
29. Hassan, Z. M., Manyelo, T. G., Nemukondeni, N., Sebola, A. N., Selaledi, L., & Mabelebele, M. (2022). The possibility of including donkey meat and milk in the food chain: a southern African scenario. *Animals, 12*(9), 1073.
30. Hlatshwayo, A. S. (2023). *Enhancing productivity and resilience of semi-arid rangelands of southwestern Zimbabwe: a case of adaptation in extensive livestock production in a communal area.* University of the Free State,
31. IFAD, E. J. A. a. S. (2021). IFAD ADVANTAGE SERIES: The Small Livestock Advantage.
32. Jasinski, M. F. (2021). *Doghole ports, a historic American landscape survey: a history of land use and management practices in California.* California State University, Sacramento,
33. Jones, J. E., Neill, D. O., Riches, C., & Sims, B. (2005). Farming Systems: Future Challenges for the Use of Draught Animals in Agricultural Development with Emphasis on Sub-Saharan Africa. *Annals of Arid Zone, 44*(3 & 4).
34. Kazimierska, K., & Kalinowska-Lis, U. (2021). Milk proteins—Their biological activities and use in cosmetics and dermatology. *Molecules, 26*(11), 3253.
35. Khan, M. Z., Chen, W., Li, M., Ren, W., Huang, B., Kou, X., . . . Khan, A. J. F. i. N. (2024). Is there sufficient evidence to support the health benefits of including donkey milk in the diet? *, 11*, 1404998.

36. Madhusudan, N. C., Ramachandra, C. D., Udaykumar, N. D., Sharnagouda, H. D., Nagraj, N. D., & Jagjivan, R. D. (2017). Composition, characteristics, nutritional value and health benefits of donkey milk-a review. *Dairy ScienceTechnology*

37. Martin-Rosset, W., Fleurance, G., Baumont, R., Cabaret, J., Carrere, P., Edouard, N., . . . Morhain, B. (2015). Pasture. In *Equine nutrition* (pp. 347-384): Wageningen Academic.
38. Martini, M., Altomonte, I., Tricò, D., Lapenta, R., & Salari, F. (2021). Current knowledge on functionality and potential therapeutic uses of donkey milk. *Animals, 11*(5), 1382.
39. Miraglia, N., Salimei, E., & Fantuz, F. (2020). Equine milk production and valorization of marginal areas—A review. *Animals, 10*(2), 353.
40. Mitchell, P. (2018). *The donkey in human history: an archaeological perspective*: Oxford University Press.
41. Mota-Rojas, D., Braghieri, A., Álvarez-Macías, A., Serrapica, F., Ramírez-Bribiesca, E., Cruz-Monterrosa, R., . . . Napolitano, F. (2021). The use of draught animals in rural labour. *Animals, 11*(9), 2683.
42. Mwinuka, R. A. (2021). *The Influence of Free-Range Grazing on Soil Degradation.* The Open University of Tanzania,
43. Nori, M. (2019). Herding through uncertainties–regional perspectives: exploring the interfaces between pastoralists and uncertainty: results from a literature review.
44. Ojango, J. M., Gitau, J., Ndiwa, N., Recha, J. W., Gachora, J., & Muigai, A. W. (2023). Integration and adoption of climate resilient management practices for enhanced productivity of sheep and goats in pastoral communities of Northern Kenya. *Pastoralism, 13*(1), 14.
45. Panel, M. M. (2020). *Meat, milk and more: Policy innovations to shepherd inclusive and sustainable livestock systems in Africa*: Intl Food Policy Res Inst.
46. Pânzaru, C., Doliș, M. G., Radu-Rusu, R.-M., Pascal, C., Maciuc, V., & Davidescu, M.-A. (2024). Equine Milk and Meat: Nutritious and Sustainable Alternatives for Global Food Security and Environmental Sustainability—A Review. *Agriculture, 14*(12), 2290.
47. Raw, Z., Collins, J. A., & Burden, F. A. (2024). What Is a Working Equid? Analysis of Current Terminology and a Suggested Definition. *Animals, 14*(14), 2026.
48. Rodrigues, J. B., Raw, Z., Santurtun, E., Cooke, F., & Clancy, C. (2021). Donkeys in transition: Changing use in a changing world. *Brazilian Journal of Veterinary ResearchAnimal Science58*, e174325-e174325.
49. Segarra, J., Fernàndez-Martínez, J., & Araus, J. L. (2023). Managing abandoned Mediterranean mountain landscapes: The effects of donkey grazing on biomass control and floral diversity in pastures. *Catena, 233*, 107503.
50. Selove, E. (2023). *The Donkey King: Asinine Symbology in Ancient and Medieval Magic*: Cambridge University Press.
51. Simberloff, D. (2013). *Invasive species: what everyone needs to know*: Oxford University Press.
52. Swai, E., & Bwanga, S. (2008). Donkey keeping in northern Tanzania: socio-economic roles and reported husbandry and health constraints. *Livestock farming, 20*(5), 1-97.
53. Vincenzetti, S., Pucciarelli, S., Polzonetti, V., & Polidori, P. (2017). Role of proteins and of some bioactive peptides on the nutritional quality of donkey milk and their impact on human health. *Beverages, 3*(3), 34.
54. Volsche, S., Wathan, J., Abbas, N., Kimwele, L. K., Capponi, G., Ontillera-Sánchez, R. R., . . . Ramasawmy, M. (2024). Cross-Cultural Variation in Human–Animal Interaction. In *Introduction to Human-Animal Interaction* (pp. 79-94): Routledge.
55. Watson, T. L., Kubasiewicz, L. M., Chamberlain, N., Nye, C., Raw, Z., & Burden, F. A. (2020). Cultural "Blind Spots," social influence and the welfare of working donkeys in brick kilns in Northern India. *Frontiers in Veterinary Science, 7*, 214.
56. Wickham, C. (2023). *The donkey and the boat: reinterpreting the Mediterranean economy, 950-1180*: Oxford University Press.

57. Zakari, F. O., Ayo, J. O., Kawu, M. U., & Rekwot, I. (2015). The effect of season and meteorological stress factors on behavioural responses and activities of donkeys (Equus asinus)–a review. *Annals of Animal Science, 15*(2), 307-321.

58. Zakari, F. O., Ayo, J. O., Kawu, M. U., & Rekwot, I. (2015). The effect of season and meteorological stress factors on behavioural responses and activities of donkeys (Equus asinus)–a review. *Annals of Animal Science, 15*(2), 307-321.

****

THE END