

Harnessing the Power of Yak Farming: The Path to Sustainable Dairying

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Abstract

Yak farming holds immense significance in high-altitude regions, providing essential resources and livelihoods for communities facing harsh environmental conditions. This article explores the role of yaks in sustainable dairying, emphasizing their adaptation to extreme climates and their cultural importance to indigenous populations. Despite facing challenges such as labour shortages and environmental constraints, yak farming offers opportunities for economic resilience and biodiversity conservation. The article discusses innovative solutions, including policy reforms, technological advancements, and the expansion of cottage industry products, to ensure the long-term sustainability of yak farming. By harnessing the potential of yak farming, communities can establish a balanced relationship between humans and the environment, promoting ecological harmony, cultural preservation, and socio-economic growth in mountainous regions.

Introduction

The yak, scientifically known as *Bos grunniens*, holds significant importance as a domestic animal thriving in harsh environmental conditions, particularly in snow-covered mountain regions like the Himalayas. Well-adapted to extreme cold, scarcity of food, low oxygen levels, and intense sunlight, yaks serve as a vital asset for communities residing at high altitudes, typically ranging from 0.4 to 0.5 kilometers above sea level. They provide essential resources such as milk and its derivatives, serve as transportation means, offer dung for fuel, and supply hides for shelter construction. Predominantly inhabiting regions like the Nepalese Himalayas, China, India (including Sikkim, Kashmir, and Arunachal Pradesh), Mongolia, and Bhutan, yaks play a crucial role in the livelihoods of rural populations in

these areas (Jiang et al., 2020; Feroze et al., 2019). The worldwide population of yaks exceeds 14.2 million, with India hosting a minimum of 7100 yaks, with over 90% of them concentrated in Sikkim. Yak milk boasts slightly distinct nutritional characteristics compared to milk from typical dairy animals, with higher levels of fat, protein, and bioactive components (Li et al., 2011; Cui et al., 2016). Yak herding serves as a primary means of sustenance for communities inhabiting high-altitude regions of the Himalayas, as highlighted by Sudmeier-Rieux et al. (2017). In mountainous areas where agricultural cultivation is challenging, yak herding emerges as a vital economic activity deeply intertwined with the cultural, religious, and social identity of these communities. However, yak herders encounter numerous challenges, including labor shortages, limited agricultural productivity in grazing lands, high yak mortality rates, and constrained market opportunities for yak products. These challenges are further compounded by socio-economic shifts, evolving policies, and the adverse impacts of climate change. Traditional practices face increasing pressures, exacerbated by the lack of innovative technologies and inadequate hygiene standards in product processing. Consequently, yak herders are confronted with a complex and precarious landscape, raising concerns about the sustainability of their livelihoods (Wangdi, 2016; Wangchuk & Wangdi, 2018; Joshi et al., 2020).

Yaks hold immense significance for ethnic communities residing in high-altitude regions, playing a central role in their way of life. These animals provide vital sustenance through milk, milk derivatives, and meat, fulfilling the nutritional needs of these populations. Additionally, yak hair is utilized for crafting sturdy shelters, offering protection against the harsh mountain environment, while yak dung

serves as an important fuel source for heating and cooking. Moreover, yaks contribute significantly to income generation through the sale of wool, hides, and trading of animals (Rai et al., 2023). Efforts to harness the potential of yak farming aim to promote sustainable practices that prioritize cultural preservation, profitability, and ecological responsibility. This involves leveraging advanced technologies, such as grazing management and precision breeding, to enhance productivity while minimizing environmental impact. Moreover, fostering collaborative partnerships among government agencies, academic institutions, and local communities is crucial for devising holistic solutions to address the multifaceted challenges associated with yak farming in high-altitude regions and ensure its long-term sustainability.

Yak Milk Product

Yak milk serves as a key dairy product sourced from yaks dwelling in high-altitude areas, renowned for its nutritional richness and distinctive taste compared to cow's milk. This milk is utilized in its fresh form or undergoes fermentation to create various dairy derivatives (**Fig.1**). Yak butter, produced by churning yak milk, boasts a creamy texture and higher fat content than conventional butter, integral to Himalayan and Tibetan culinary traditions. Yak ghee, derived from yak butter through a process of simmering to eliminate water and milk solids, offers a flavorful, nutty essence and is preferred for high-altitude cooking techniques due to its elevated smoke point. Yak yogurt, a fermented product resulting from culturing yak milk with beneficial bacteria, delivers a tangy flavor and creamy consistency, commonly enjoyed as is or incorporated into diverse culinary creations. Yak cottage cheese, known locally as chhurpi, is crafted by coagulating yak milk and subsequently pressing and aging the curds to yield a mildly tangy cheese, frequently employed in soups, stews, or as a snack. Yak hard churpi, another derivative, is a robust cheese made by boiling yak milk, then pressing and drying the curds, resulting in a firm, chewy texture suitable for prolonged storage and serving as a valuable protein source during harsh

winters or treks in high-altitude regions (Wang et al., 2023).

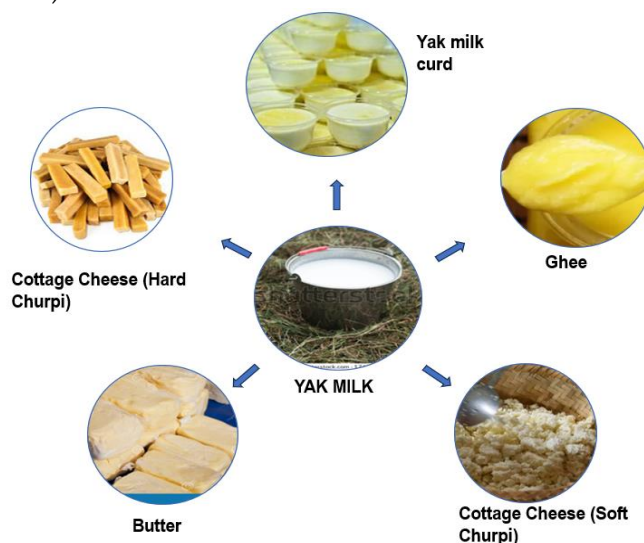


Fig. 1 Yak milk derivatives

Benefit of Yak Herding

Yak herding in high-altitude regions plays a crucial role in benefiting both local inhabitants and the environment. These resilient animals serve as a dependable source of income and sustenance for communities, as they provide various products such as milk, meat, wool, and hides, thereby supporting livelihoods in isolated areas. **Fig. 2** shows different products from yak milk with their benefits. Their ability to thrive in harsh conditions with minimal vegetation ensures food security for locals while also maintaining the ecological equilibrium of alpine ecosystems. Through their grazing habits, yaks promote biodiversity and soil health, thus preserving the delicate balance of these regions. Additionally, yak herding holds significant cultural importance for indigenous populations, fostering social cohesion and contributing to the preservation of community identity in high-altitude settings (Rai et al., 2023).

Challenges Faced During Yak Herding

Yaks face significant environmental challenges in high-altitude regions. The thin air, low in oxygen, presents a hurdle for many creatures, but yaks have adapted with larger lungs and hearts, allowing them to efficiently breathe in such conditions. Harsh cold is another obstacle, but yaks' thick fur coats provide insulation against freezing temperatures, ensuring their warmth. Despite the scarcity of food in rugged terrains with sparse vegetation, yaks have evolved to



Fig. 2 Different products from yak milk with their benefits

thrive on tough grasses and shrubs, supported by their specialized digestive systems. Despite these challenges, yaks' robust build and sure-footedness aid them in navigating rocky slopes, while their social behavior offers protection against predators such as snow leopards and wolves. These adaptations enable yaks to not only endure but also thrive in the demanding environments of high altitudes (Sapkota et al., 2022; Joshi et al., 2020). In the high-altitude regions characterized by sparse vegetation, ensuring an adequate food supply for yaks poses a significant challenge for farmers. With limited plant life available for grazing, yaks must rely on tough, fibrous grasses and shrubs for sustenance, which may not always meet their nutritional needs. This can lead to reduced milk production and slower growth rates in yak calves, ultimately impacting the overall productivity of the herd. To mitigate these challenges, farmers must carefully manage grazing areas to prevent overgrazing and soil degradation. Moreover, fluctuations in weather patterns and seasonal changes in forage availability further complicate yak farming, necessitating the implementation of adaptive strategies to maintain the well-being and productivity of the herds amidst the constraints of sparse vegetation (Kumar et al., 2021). Wangchuk and Wangdi (2018) indicated in their study that the shrinking of high-altitude areas is resulting in a decline in both the quality and quantity of agricultural production, consequently leading to reduced milk production. Likewise, yak farming in high-altitude regions encounters the obstacle of rugged terrain, marked by steep slopes and rocky surfaces. This

landscape poses challenges for farmers in accessing grazing areas and ensuring proper care for their yaks. The uneven ground heightens the risk of injury for both yaks and farmers, and traversing the terrain demands considerable time and labor. Despite these hurdles, yak farmers implement creative approaches like terracing and rotational grazing to optimize land utilization and mitigate the effects of rugged terrain on their farming practices (Krishnan et al., 2016).

Future Solution of Yak Harding

Addressing opportunities in yak farming involves three main categories: policy innovations, technological advancements, and the expansion of cottage industry yak products. Policy innovations encompass the development and implementation of strategic plans and regulations aimed at protecting yak populations and their habitats. This includes measures to conserve grazing lands, prevent habitat degradation, and manage human-wildlife conflicts effectively. Technological interventions focus on adopting advanced tools and techniques to enhance yak husbandry practices and increase productivity. Examples include precision breeding methods, remote sensing technologies for pasture management, and veterinary telemedicine services for yak health monitoring and treatment. Additionally, the development of cottage industry yak products aims to diversify the range of value-added goods derived from yak milk, meat, and wool. This could involve producing gourmet cheeses, artisanal textiles, and skincare products, thereby creating new income streams for yak farmers and bolstering economic resilience in high-altitude communities. Prompt attention to these areas is essential for ensuring the long-term sustainability and prosperity of yak farming, preserving cultural heritage, and fostering socio-economic growth in mountainous regions (Dorji et al., 2020).

Conclusion

Harnessing the potential of yak farming presents a pathway towards sustainable dairy production that not only sustains communities but also safeguards fragile high-altitude ecosystems. By utilizing yaks and their various products such as milk, meat, wool, and hides, one can establish a balanced

relationship between humans and the environment. Yak farming not only ensures vital nutrition and income for remote mountain communities but also contributes to biodiversity conservation and responsible environmental management. Embracing yak farming practices cultivates resilience in the face of climate change and socioeconomic challenges. Furthermore, sustainable yak farming practices support cultural preservation and community empowerment, safeguarding traditional knowledge and practices. In summary, leveraging the power of yak farming offers a comprehensive approach to sustainable dairy production, founded on principles of ecological harmony, social justice, and economic sustainability, thereby laying the groundwork for a brighter and more resilient future for all stakeholders involved.

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