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Original article

Management and Conservation of Ladakh Yak under Trans-Himalayan Conditions"

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INTRODUCTION

The yak (Bos grunniens) is a very hardy bovine animal that is specially suited to the harsh high-altitude conditions of the Tibetan Plateau and nearby mountainous areas of Central Asia. Yaks can withstand extreme cold (up to −40 °C), low oxygen levels, intense UV radiation and little flora while thriving at elevations between 2,000 and 5,000 m above mean sea level (Miao et al., 2015; Silanikove et al., 2016). Yaks are essential to the cultural and economic survival of several Himalayan ethnic groups, such as the Monpa, Brokpa and Changpa populations, who rely on them for milk, meat, fibre, transportation and dung, in addition to their ecological adaption. . The Ladakhi yak is a significant genetic resource of the Union Territory of Ladakh in India. It is recorded with ICAR-NBAGR under accession number INDIA_YAK_3800_LADAKHI_16002. The Zanskar and Karakoram ranges encircle the trans-Himalayan region of Ladakh, one of the world's most densely populated areas. With temperatures ranging from −40 °C in winter to 35 °C in summer, low humidity (25–40%), little precipitation (80–300 mm)and a lower oxygen content (60–70% of sea-level levels), the area has an arid, cold desert environment. Ladakhi yaks have developed physiological and behavioural characteristics that allow them to survive and be productive in spite of these harsh circumstances.

Morphological and Physiological Characteristics of Ladakhi Yak

Medium-sized and robust, Ladakhi yaks are ideally suited to the bitterly cold and dry high-altitude plateaus of Ladakh. They have a large occipital region, a straight forehead and nasal bone and grey-to-black horns (Sharma et al., 2018). They usually have a glossy, dark brown to black coat with moderately long outside hair and a fine, dense undercoat that offers superior thermal insulation.

There are also sporadic white areas. According to Pal et al. (2017), adult males weigh an average of 250 kg, while females weigh between 180 and 190 kg.

The yak's remarkable ability to withstand cold is mainly due to its compact body form and thick coat, which let it save heat rather than generate it (Silanikove et al., 2016). In terms of physiology, Ladakhi yaks have large hearts and lungs, thin-walled pulmonary arteriesand no pulmonary vasoconstriction, all of which improve oxygen transport and utilisation in hypoxic environments. In conditions with little oxygen and extreme temperatures, their high basal metabolic rate and effective oxygen-binding haemoglobin further boost survival and productivity (Miao et al., 2015).

Housing System

In Ladakh, the main method of raising yaks is a historic transhumance system in which herders move their animals seasonally between lower winter settlements and high-altitude summer pastures. Despite being well suited to the delicate alpine habitat, this system is still very disorganised and physically taxing. Depending on altitude, season and resource availability, semi-intensive and extensive housing designs are frequently used in this area. Yaks are transported to temporary enclosures or stone-walled pens close to herder camps at night during the grazing season in order to protect them from predators and inclement weather (Ali et al., 2016). Yaks are kept on open range lands during the day.

Locally known as doksa or phu, traditional yak shelters are often kaccha-style constructions composed of stones joined with mud mortar. Thatch, mud and twigs are commonly used to build roofs because they offer insulation against Ladakh's bitterly cold temperatures. In order to prevent heat loss and keep the animals' microenvironment warmer during the winter, some herders also employ semi-underground sheds. Although these shelters frequently lack drainage and adequate ventilation, which leads to the buildup of dung and ammonia fumes, flooring is typically a stone–mud mixture that helps preserve warmth (Bharti et al., 2017).

In order to maintain appropriate inside temperatures during periods of heavy snowfall, farmers employ artificial heating or fumigation and clean the sheds occasionally, usually every few days. Although these small housing systems are efficient at preserving heat, they present problems for animal health and hygiene. However, this conventional method is still essential to the trans-Himalayan region's yak production system.

Feeding Management

Yak feeding management in Ladakh's high-altitude regions is mostly dependent on large-scale grazing systems that make use of naturally occurring alpine meadows. During the brief summer months when pastures are fertile, yaks and other livestock graze on the available herbage. Angmo et al. (2016) state that grazing continues to be the primary feeding method all year round in eastern Ladakh, where the feeding system is mostly dependent on locally accessible resources. Stall feeding is crucial during the long, hard winter when access to pasture is restricted by heavy snowfall. In order to keep cattle alive during times when feed is short, nomadic herders frequently stock dry fodder, such as wheat straw, barley straw and native grasses. However, because concentrates and oil cakes are expensive and scarce, their use is uncommon. During this time, feeding is typically modest and concentrated on preserving bodily condition rather than production. Because yaks have a large appetite for common salt, supplementing with it is a typical practice. Herders also use it to help gather animals returning from pastures (Angmo et al., 2016). On the other hand, among communities that raise yaks, the usage of mineral mixes or prepared diets is still rare. In general, the yak feeding system in Ladakh and other trans-Himalayan regions is still resource-dependent and traditional, with recent changes towards winter feed storage techniques to reduce losses brought on by a lack of fodder and harsh weather.

Ladakhi Yak's Regional Significance

For the trans-Himalayan region of Ladakh, the Ladakhi yak is extremely important on an ecological, culturaland economic level. For high-altitude pastoral cultures like the Changpa, Brokpa and Monpa, it provides vital resources including milk, meat, fibre, hide, transport and manure. Yak milk and its by-products, like butter, ghee and chhurpi (hard cheese), are essential to the local diet and rural economy (Wiener et al., 2003).

Yaks and their hybrids, such Dzomo and Garmo, are vital to the nomadic herders' ability to maintain their household income. Yak and cattle have been crossed to increase milk yield and docility, which makes the hybrids more manageable and productive at lower elevations (Jasra et al., 2016). In addition to producing more milk than female pure yaks, the hybrids are better able to adjust to changing weather patterns and food sources.

Beyond direct production, the yak is essential for transportation and draft power in difficult, high-altitude environments where mechanised mobility is not feasible. Yak dung's ecological and energy significance is shown by the fact that it is the main fuel source in places without firewood. Additionally, because yak products come from pure pastures and are naturally organic, they command high prices in regional and speciality markets (Wangda, 2016).

Prospective Approaches

1. Genetic Characterisation: To evaluate genetic diversity and phylogenetic linkages, a thorough molecular-level genetic characterisation of yak populations in various Ladakh regions should be carried out. Finding distinctive genetic characteristics and adaptive markers peculiar to the Ladakhi yak will be aided by comparative research with yak populations from China and other regions of India.

2. Scientific Breeding and Management: To preserve pure genetic lines while increasing productivity, a scientifically developed breeding policy should be implemented based on genetic and performance data. To boost productivity and sustainability, better management systems—such as those for nutrition, healthcare and reproductive management—must be put in place.
3. Value Addition to Yak Products: The commercialisation and value addition of yak-derived goods such milk, cheese, butter, fibre, hair, pelt and bones should be the main priority. Pastoral communities can greatly increase their income by building processing facilities, branding regional yak products and connecting them to high-value niche markets.
4. Tourism Integration: While raising knowledge of traditional yak husbandry and conservation, promoting yak-based ecotourism activities, such as yak safaris and cultural festivals, can offer local herders alternate sources of income.
5. Use as Pack Animals: Ladakhi yaks should be used as pack animals for transportation and logistical assistance in remote and border regions, particularly for defence and paramilitary activities, due to their remarkable endurance and adaption to high-altitude terrains.
6. Molecular Adaptation Studies: To comprehend the molecular processes behind hypoxia tolerance and environmental adaptation in yaks, research on adaptive genes like Metallothionein-III (MT-III) and Hypoxia-inducible protein 1 (HP1) is crucial. Programs for conservation and genetic improvement may benefit from the findings of such investigations.

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