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Dumba Sheep: A resilient fat-tailed breed

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Dumba sheep, also known as fat-tailed or rump tail sheep Dumba sheep are distinguished by their large, fat-filled tail or rump (the back end), which is distinct from conventional sheep. Dumba sheep concentrate fat in their tails**,** keeping the rest of their bodies lean. It is believed that fat-tailed sheep were bred to survive the tough conditions of the grasslands and deserts in Central Asia around 3,000 BC. This happened thousands of years after their ancestors, the thin-tailed sheep, were first domesticated. Over time, these fat-tailed sheep spread east to northern China and west to South Africa. At present, fat-tailed sheep are found in Iran, Israel, Jordon, Syria, Turkey, Indonesia, Lebanon, Ethiopia, South Africa, Zimbabwe, China, Afghanistan, Pakistan etc. (Pourlis, 2011). More than 96% of Iranian sheep are fat-tailed and the remaining 4% are thin-tailed and semi-fat-tailed (Kiyanzad, 2005), around 80% of sheep population in China are fat-tailed. Interestingly, some fat-tailed sheep of unknown breeds are found in urban and peri-urban areas of Rajasthan, Jammu & Kashmir, and Uttar Pradesh in India. Most of these sheep are raised in stalls for meat production and are sold in markets during festivals.

Fat-tailed Awassi and Karakul sheep are well known for their milk and pelt production. Earlier, a few studies on these breeds were conducted at ICAR-Central Sheep and Wool Research Institute, Avikanagar (Rajasthan). However, the present fat-tailed sheep found in the country is different from Awassi and Karakul breeds and are reared for producing meat. These sheep are well-suited for arid and semi-arid regions of the country providing essential products such as meat, milk, and wool. In a study by Mishra and colleagues, the average body weight of adult rams is 83.89 kg, while ewes' average 58.76 kg, indicating their large size compared to other breeds. The predominant coat color of Dumba sheep is white, followed by brown and black-white mixtures. A flock of fat-tailed sheep is being maintained at ICAR-CSWRI, Avikanagar and preliminary studies have been initiated on growth, production, reproduction and wool production. The faster growth of these animals as indicated by higher body weights at different age shows the potential of Dumba sheep in enhancing the mutton production. At birth, 3, 6 and 9 months, the body weight is around 5.0 kg, 33.8 kg, 51.7 kg and 81.6 kg respectively. The growth performance of Dumba crossed with native breeds like Malpura and Patanwadi is also commendable.

A defining characteristic of Dumba sheep is their massive fat tail, but what purpose does this serve? The answer lies in energy storage and thermoregulation**.** Tail fat and rump fat are often considered adaptive responses of animals to extreme environments (McManus et al., 2022) serving as valuable energy reserves during migration and in times of feed unavailability during extreme climatic conditions (Moradi et al., 2012). Notably, approximately 25% of the world's sheep population consists of fat-tailed breeds (Moradi et al., 2012). Well-adapted breeds exhibit specific localized fat deposition, particularly in the tail. This external localization of fat allows better heat dissipation by other organs (Degen and Shkolnik, 1978). The fat tail constitutes a vital energy reserve for some sheep breeds in arid and semi-arid regions, especially during shortage of food and water, thus safeguarding survivability and productivity (Chilliard et al., 2000; Atti et al., 2004). Some fat-tailed breeds are extensively used as maternal breeds in tropical conditions, and they have the ability to accumulate and mobilize body fat in internal fat depots (Chay-Canul et al., 2011). The tail functions as a built-in energy bank. During periods of food scarcity, Dumba sheep can metabolize the stored fat, similar to how camels

utilize their humps. Unlike thin-tailed sheep that distribute fat throughout their bodies. This adaptation helps them stay cool in hot climates**,** preventing overheating. In dry, arid environments, these sheep have evolved to require less water than other breeds. The metabolism of their fat reserves also produces water, reducing their dependence on external water sources. The physiology of Dumba sheep equips them to handle high temperatures, droughts, and poor-quality forage. Their short, thin coat minimizes heat absorption, while the large fat tail prevents fat from insulating their bodies. Some breeds even have larger ears to help dissipate heat. Despite their leaner bodies, these sheep develop high-quality, flavorful meat, which is especially prized in many cultures. The tail fat is often used in traditional cooking, replacing oils and butter. The average weight of the rump fat is 4 kg. Comparing the muscle fatty acid composition in Dumba sheep and Malpura sheep breed which is also a meat type breed and is thin-tailed, Dumba had relatively more polyunsaturated fatty acid while Malpura ewes had more saturated fatty acid in meat (Bhatt et al., 2020).

The distinguishing quality of fat tails in sheep is influenced by multiple genetic factors. Studies have identified several genes and molecular mechanisms that contribute to this observable characteristic. Some of the genetic factors involved in fat-tail development, supported by evidence from various studies include *BMP2* (Bone Morphogenetic Protein 2), *PDGFD* (Platelet-Derived Growth Factor D), *LPL* (Lipoprotein Lipase), *POSTN* (Periostin) gene, *HOXA11* (Homeobox A11) and other candidate genes. *BMP2* is a critical regulator of adipogenesis and fat deposition in sheep tails. It induces adipogenesis by upregulating key adipogenic factors such as PPAR-γ (peroxisome proliferator-activated receptor gamma) and LPL (Jin et al., 2022, Lu et al., 2020). *PDGFD* is another key gene associated with fat-tail development. It regulates adipocyte maturation contributing to the accumulation of fat in the tail. Histological and gene expression analyses have shown that PDGFD expression is higher in fat-tailed breeds (Dong et al., 2020). LPL is involved in lipid metabolism and fat deposition. It catalyzes the hydrolysis of triglycerides, making fatty acids available for

Brown Dumba Ram at ICAR-CSWRI, Avikanagar

White Dumba Ram at ICAR-CSWRI, Avikanagar

Photo of male Dumba (Left), Dumba ewe with lambs (Right)

storage in adipocytes. Allele-specific expression (if one copy of a gene is favorably expressed over another) of LPL has been observed in fat-tailed breeds, suggesting its role in influencing fat acc umulation (Mansourizadeh et al., 2024, Lu et al., 2020).

A study comparing sheep and goat rearing found that sheep farming, particularly with fat-tailed breeds, offers higher net returns under intensive rearing systems (Shivakumara & Kiran, 2019). Their adaptability to harsh environments, such as arid and semi-arid regions, allows them to thrive in areas where other breeds may struggle (Mohapatra & Shinde, 2018). This adaptability ensures consistent productivity and contributes to food security and livelihoods in rural households. This suggests that investing in fat-tailed sheep can be economically rewarding. India, as an agrarian country, has relied on sheep production for economic, agricultural, and cultural purposes. In recent years, Dumba sheep farming has gained momentum in the country, offering new opportunities for livestock farmers. The ICAR-Central Sheep and Wool Research Institute (CSWRI) achieved a significant milestone by crossbreeding Dumba rams with Malpura ewes. A notable outcome was a crossbred male lamb that reached a body weight of 45.4 kilograms at six months of age**,** starting from a birth weight of 3.7 kilograms. This crossbreeding strategy aims to enhance meat production and bridge the gap between demand and availability in the country. Dumba sheep is often crossbred with Patanwadi and Marwari ewes (Jyotsana et al., 2010). Farmers like Nabibul from Bankura, West Bengal**,** have embraced Dumba farming with remarkable success. Facing economic challenges during the COVID-19 pandemic, Nabibul invested in five Dumba sheep sourced from Rajasthan. Over three years, his flock grew to 18 sheep, with an estimated market value exceeding 15 lakh rupees. His venture not only provided financial stability but also inspired others in his village to consider Dumba farming as a viable livelihood.

As climate change continues to impact agriculture worldwide, livestock capable of withstanding extreme conditions are becoming increasingly valuable. Dumba sheep could play a pivotal role in sustainable livestock farming, especially in regions facing. Their heat tolerance makes them suitable for hotter climates. Their efficient water use and ability to thrive on low-quality forage make them ideal for arid regions. Their adaptability allows them to graze on vegetation that other breeds might not utilize effectively. Given their unique physiology, Dumba sheep might also be used in crossbreeding programs to enhance heat and drought tolerance in other sheep breeds with lower genetic merits. Researchers and farmers are exploring how these genetic adaptations could help secure food production in changing environments.

Lastly, the growing population, higher incomes, urbanization, and changing food preferences are increasing the demand for animal products, putting pressure on livestock to produce more. Dumba sheep are more than just an unusual-looking breed; they are living examples of nature's resilience and adaptability. With their energy-storing fat tails, water-efficient metabolism, and resistance to harsh climates**,** they are perfectly designed for survival. As India embraces Dumba sheep farming, this breed not only offers economic opportunities but also represents a sustainable solution for livestock farming in the face of climate change.