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Vrindavani Cattle: An Efficient Crossbred for Dairy Farming Systems

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Abstract:

India's livestock sector plays a vital role in the agricultural economy, contributing significantly to national milk production. Among crossbred cattle developed through systematic breeding programs, Vrindavani has emerged as a promising composite breed with high productivity and adaptability. Developed at the Indian Veterinary Research Institute through a four-breed cross involving Hariana, Holstein Friesian, Jersey, and Brown Swiss, Vrindavani combines desirable traits of both indigenous and exotic cattle. The breed exhibits good adaptability to tropical conditions, supported by genetic factors such as heat tolerance and improved milk synthesis. Vrindavani cattle demonstrate moderate to high milk production, yielding about 3,000 kg per lactation under field conditions, with a standardized 305-day yield of approximately 2,630 kg. Reproductive traits are also favorable, with early maturity, optimal calving age, and efficient post-partum recovery. Morphological and udder characteristics further support their dairy suitability. However, performance varies with management, nutrition, and environmental factors. Despite a slight decline in genetic diversity, ongoing conservation efforts have improved genetic management. Overall, Vrindavani cattle represent a sustainable and economically viable option for small and marginal farmers, with strong potential for future genetic improvement through advanced breeding and field-based selection programs.

Keywords: Vrindavani, crossbred cattle, milk production, four-breed cross, adaptability.

Introduction:

In India, the livestock sector forms a significant part of the agricultural economy. Its contribution to agriculture and allied sector GVA has shown steady growth, increasing from 24.38% in 2014–15 to 30.23% in 2022–23. During 2022–23, it represented 5.50% of the country's total GVA. By 2023, India recorded around 308 million cattle, the largest population worldwide. India remains the world's leading milk producer, with an annual output of 230.58 million tonnes in 2022–23. This consistent growth in milk supply is supported by an expanding female cattle population, which has increased by 18% compared to the 2012 livestock census (DAHD, 2023–24). Exotic and crossbred cattle, with a population of 51.36 million, contribute nearly 32% to total production, while indigenous or non-descript cattle, numbering 142.11 million, account for approximately 21% (BAHS 2023-24) (Fig. 1).

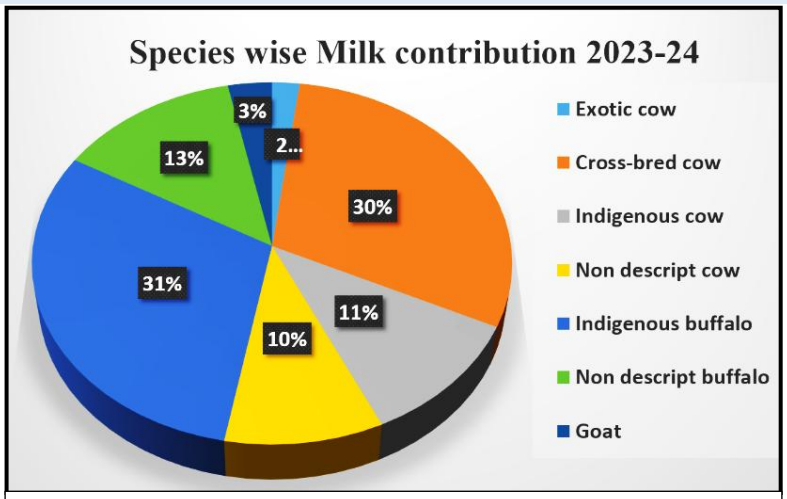

Fig. 1. Species wise Milk contribution (2023-24)

The steady growth in milk production indicates that crossbred cattle outperform indigenous breeds and are increasingly favored by farmers. For the last 40 years, India has been developing new crossbred varieties by integrating indigenous and temperate exotic cattle. These programs expanded significantly after 1970 when ICAR initiated focused crossbreeding projects.

Breed Development:

In 1968, a four-breed crossbreeding program was started at the Indian Veterinary Research Institute. A base population of 400 indigenous Hariana cattle was artificially inseminated using semen from Holstein Friesian (HF), Jersey, and Brown Swiss (BSW) breeds. This resulted in three genetic groups: 1/2 Hariana × 1/2 HF, 1/4 Hariana × 1/2 HF × 1/4 BSW, and 1/4 Hariana × 1/2 HF × 1/4 Jersey. These groups were assessed over seven generations for their production, reproductive performance, and adaptability to environmental conditions. Through continued inter-mating and careful selection, the modern composite breed Vrindavani (Fig. 2) was developed, comprising 25–50% *Bos indicus* and 50–75% *Bos taurus* inheritance (Singh et al., 2011).

Fig. 2. Vrindavani cow reared at Cattle and Buffalo Farm, ICAR-IVRI, Izatnagar

Adaptability, Genetic Traits, And Dairy Potential:

Vrindavani cattle are well suited to the agro-climatic conditions of northern India, particularly in Uttar Pradesh, Uttarakhand, and Rajasthan, where they are widely preferred by dairy farmers due to their

adaptability and productivity (DARE/ICAR Annual Report 2007–08). Being adapted to tropical environments, the HSPB6 gene plays an important role in their heat tolerance, similar to that observed in indigenous and tropical breeds such as Sahiwal, Gir, and South African Zebu (Kumar et al., 2015; Makina et al., 2015; Dash et al., 2022). In addition, Vrindavani cattle exhibit higher milk production compared to their indigenous parent breed, Hariana. This improved performance is associated with increased activity of genes influencing milk quality, including those related to milk protein synthesis (such as CENPN, CMIP, NECAB2, OSGIN1, and CLNK) as well as genes involved in mineral content like copper, iron, and phosphorus regulation (Goli et al., 2025).

Fig. 3. Different coat appearance of Vrindavani cow

Morphological And Udder Characteristics of Vrindavani Cattle:

Vrindavani cattle exhibit diverse coat colours, with brown shades being most common, while black, white, and beige animals are also seen (Fig. 3). Coat patterns may be uniform or show variations such as spotted, patchy, or shaded forms. Seasonal variation affects coat traits in Vrindavani cattle, with spring favouring higher coat thickness, winter favouring longer and heavier hair, and summer-calving animals showing increased hair density (Prabhakar et al., 2018). The forehead is generally light-coloured, though darker variations also occur, and the muzzle is typically grey, contributing to the breed's distinct appearance. Structurally, these animals have a well-proportioned, medium-sized body with a compact and dairy-type build. The head is clean-cut with a slightly concave forehead and a prominent poll (Fig. 4). The neck is long, lean, and neatly shaped, while the eyes are moderate in size and alert in expression. Ears are medium-sized, laterally oriented, and rounded at the tips, giving facial symmetry. The legs are strong,

Fig. 4. Forehead and poll appearance of Vrindavani cow

straight, and well aligned, supporting smooth movement. The rib cage is well sprung, providing adequate space for internal organs and supporting efficient digestion. The tail switch varies in colour within the population. The coat is short to medium in length, smooth, and glossy, indicating good adaptability to the local environment.

Udder structure shows variation, including trough, bowl, round, and pendulous types, with medium-sized fore and rear udders and well-formed teats that facilitate milking. Teat shapes are mainly cylindrical and funnel-like, while other forms are less common. Overall, these morphological and udder traits reflect the breed's suitability for dairy production and adaptability under field conditions.

The Vrindavani cattle generally exhibit a calm to moderately active temperament, making them relatively easy to handle and suitable for routine dairy management. Their behaviour is typically manageable, which is an advantage for farmers in both small- and large-scale operations.

Sex and Seasonal Effects on Calf Growth Performance:

Male calves show better growth than females. Calves born during March–June attain higher body weight and growth rates due to favourable climatic conditions, whereas those born in extreme seasons perform poorly (Sagar et al., 2017). Improved feeding and management during critical periods can enhance overall growth performance.

Productive and Reproductive Performance:

Milk yield improves with proper nutrition, but it may decline due to poor management practices and seasonal variations. (Zamoraro et al., 2023). Vrindavani crossbred cows exhibited lower LMY when raised in field conditions relative to farm conditions. (3660.92±99.41 kg; IVRI Annual Report, 2018-19). At field level**,** a cow produces about 3,000 kg of milk per lactation, with the lactation lasting approximately 348 days, indicating a relatively long and productive milking cycle (Rajkumar, 2020). When standardized to a 305-day lactation period (a common benchmark in dairy evaluation), the average milk yield is around 2630 kg. In terms of peak performance, these cows typically reach a maximum daily milk yield of about 13 kg. The performance of Vrindavani crossbred cows is comparatively better than other crossbred cattle populations under field conditions. However, their performance at field level is lower as compared to farm level. Female fertility is assessed through reproductive traits including age at first calving, calving interval, dry period and service period, which are crucial in breeding programs (Gangwar et al., 2023). Vrindavani cattle show well-defined reproductive performance parameters that reflect their adaptability and productivity. On average, heifers attain their first service at around 678 days. The age at first calving is approximately 1,010 days. The gestation period in Vrindavani cattle averages about 278 days (Singh et al., 2011), which is consistent with most cattle breeds and ensures normal fetal development. After calving, cows generally return to heat with estrus signs (Fig. 5) in about 90 days, showing a reasonably good recovery and readiness for the next breeding cycle. The production efficiency of Vrindavani cattle was, on

the whole, higher than that of other crossbred populations in the nation. Moreover, Vrindavani cows were ideal for low-income farmers in western Uttar Pradesh and displayed remarkable performance (Singh et al., 2011).

Fig. 5. Estrus signs in Vrindavani cow

Rural Management Practices:

Genetic makeup, nutrition, health status, and management practices play key roles in determining cattle production and reproduction performance. However, rural livestock production in India is hindered by problems such as poor housing, inadequate feed resources (Sen et al., 2014), high treatment costs, and inappropriate ethno-veterinary practices (Mishra and Patro, 2010), as well as lower genetic potential. Vrindavani cattle is managed with proper newborn care, such as cleaning calves with straw or cloth and feeding colostrum soon after birth. Feeding include green fodder like berseem and grasses, dry fodder such as wheat straw, and homemade concentrate (Fig. 6). Animals are housed in well-ventilated sheds with lean-type roofs, brick flooring, and basic drainage facilities.

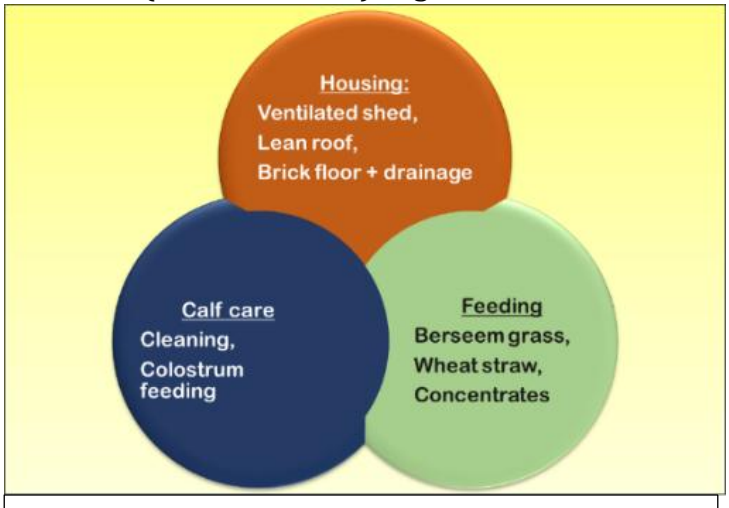

Fig. 6. Management at village level

Pedigree Analysis and Diversity Changes:

Vrindavani, crossbred cattle, has an average ancestry composition of 39.5% from Holstein Friesian, 22.9% from Jersey, 26.9% from Hariana, and 10.7% from Brown Swiss breeds (Ahmad et al., 2020). Vrindavani, crossbred cattle, has an average ancestry composition of 39.5% from Holstein Friesian, 22.9%

from Jersey, 26.9% from Hariana, and 10.7% from Brown Swiss breeds (Ahmad et al., 2020). The Vrindavani cattle population shows good but slightly declining pedigree record completeness in older generations. It originated from 2,620 founders, but only a small portion effectively contributed to current genetics, indicating limited ancestral diversity. Overall, genetic diversity has reduced by about 5.3%, though conservation measures have improved genetic management over time (Gangwar, 2025)

Conclusion And Future Prospectives:

The production performance of Vrindavani cattle appears to surpass that of many other crossbred cattle developed in India. Their ability to maintain consistent milk yield, combined with adaptability to local environmental conditions, makes them a strong candidate for dairy farming systems. Given the present economic conditions, there is a growing need to promote dairy animals that are both cost-effective and well-suited to local resources. For small and marginal farmers in western Uttar Pradesh, sustainable and low-maintenance breeds are especially important. In this context, Vrindavani cattle stand out as a highly suitable option.

Through the use of careful management of inbreeding, advanced machine learning tools and selective breeding approaches the research study can be helped to advance dairy cattle breeding programs in India. To assess the genetic value of Vrindavani bulls in real-world conditions, a field progeny testing scheme is required, enabling the identification and use of superior bulls in breeding programs.

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