Revolutionizing dairy breeding: Introduction of ABS sexed semen in India

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Summary

India's dairy industry, the largest globally, plays a vital role in supporting rural livelihoods and national food security. Despite its scale, the sector continues to face key challenges, notably low productivity per animal and a significant gender imbalance in calves born through conventional breeding methods. The birth of male calves, which do not contribute to milk production, imposes an economic burden on farmers and limits genetic advancement. In this context, sexed semen technology offers a revolutionary solution by enabling over 90% probability of female calf births. This manuscript presents the pioneering initiatives of ABS India in introducing, indigenizing, and scaling this biotechnology across the country. It highlights the strategic establishment of sexing laboratories, production capacity growth, collaborations with state governments, and field-level results. Data from diverse geographies demonstrates increased female calf ratios, improved milk yields, and substantial economic benefits for dairy farmers. The study underscores sexed semen as a critical tool for enhancing genetic gain, productivity, and profitability in India's evolving dairy sector.

Keywords: Sexed Semen, Artificial Insemination, Dairy Breeding, ABS India, Productivity, Calf Gender Ratio, India Dairy Industry, Dairy Genetic Enhancement,

Introduction

India has firmly established itself as the world's largest milk producer, contributing more than 239 million metric tonnes (MMT) of milk annually as of 2023–24 (NDDB, 2024). The dairy sector is a cornerstone of the rural economy, directly supporting over 80 million farm households, most of whom are small and marginal farmers. Despite this impressive scale, the average productivity per animal in India remains significantly lower than that of global counterparts like the United States or the European Union. One of the major contributors to this productivity gap is the inefficient breeding system, where the ratio of productive female to unproductive male calves remains skewed.

Traditional artificial insemination (AI) practices do not distinguish between sperm carrying X (female) or Y (male) chromosomes, resulting in an approximately 50:50 sex ratio. This leads to a surplus of male calves, which are not only unviable in terms of milk production but also impose additional rearing and welfare costs on farmers. Moreover, the presence of unwanted male calves increases the risk of abandonment, misuse, or unethical disposal practices. Addressing this challenge is critical to improving both the economic viability and the sustainability of dairy operations.

Sexed Semen technology emerges as a transformative solution in this context. By employing advanced flow cytometry-based sperm ablation techniques, sexed semen

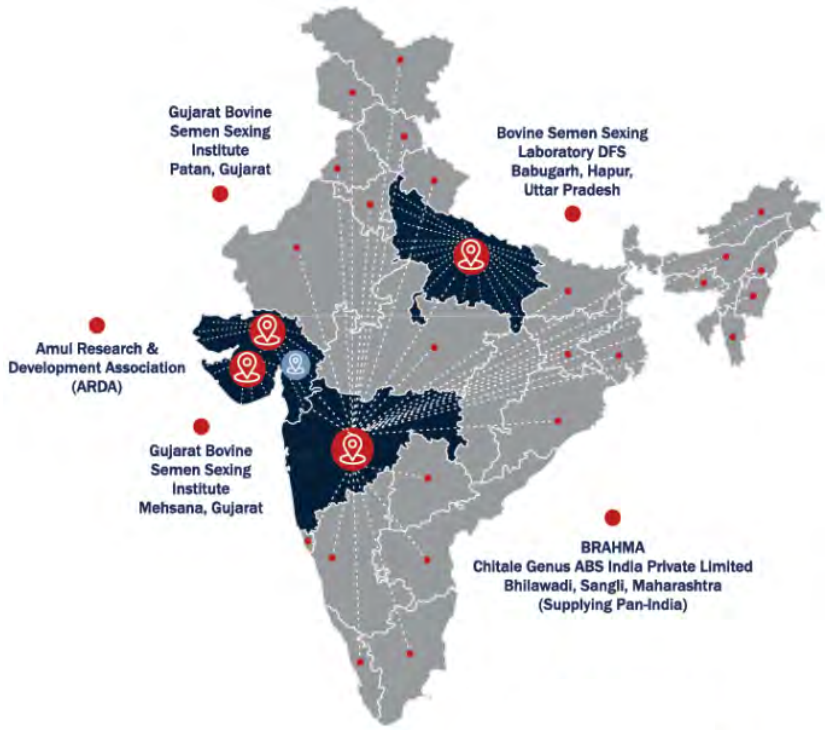
increases the likelihood of female calf births to over 90%. This not only ensures that the next generation of dairy animals are genetically superior females but also improves herd replacement rates, genetic progress, and overall milk output. In countries like the USA, Brazil, and China, the adoption of sexed semen has led to measurable gains in dairy productivity and profitability.

In India, ABS India, a subsidiary of ABS Global and Genus PLC, has taken a pioneering role in promoting Sexed Semen since 2017. The organization has invested in state-of-the-art production labs, introduced Indian-specific genetic selection indices like the Indian Dairy Index (IDI), and established partnerships with state livestock development boards and cooperatives. Through extensive training of AI technicians, deployment of high-genetic-merit bulls, and close coordination with the government, ABS India has scaled the technology across multiple Indian states, thereby contributing to a more productive, profitable, and sustainable dairy ecosystem.

Materials and methods

This study documents the operational model, scale-up strategy, and field-level outcomes of ABS India's sexed semen initiative launched in 2017. A joint venture with BG Chitale Dairy, ABS India set up India's first commercial sexed semen production laboratory at Bramha, Sangli (Maharashtra), India; utilizing cutting-edge flow cytometry-based sperm ablation technology. This technique allows for the preservation of X (female) and ablation Y (male) chromosome-bearing sperm cells by detecting minute differences in their DNA content. The X-bearing sperm is then processed into straws using cryopreservation techniques under highly controlled laboratory conditions.

The production capacity, which started at approximately 2 lakh sexed semen straws in 2017, was expanded through the commissioning of additional labs and equipment upgrades. By 2024, ABS India's annual sexed semen production exceeded 15 lakh



doses, with cumulative production surpassing 75 lakh doses by early 2025. The labs are equipped with Class 100000 cleanroom environments, stringent quality control protocols, and trained biotechnologists, ensuring consistent sexing accuracy and sperm viability.

To track field performance and outcomes, data were systematically collected from:ABS India's Management Information System (MIS) for production and supply records;

Field reports submitted by officials trained AI technicians from 13 Indian states;

NDLM Bharat Pashudhan database MIS reports

Collaborative inputs from State Animal Husbandry Departments, veterinary hospitals, and Government of India's Rashtriya Gokul Mission (RGM) with NDDB's implementation partnership.

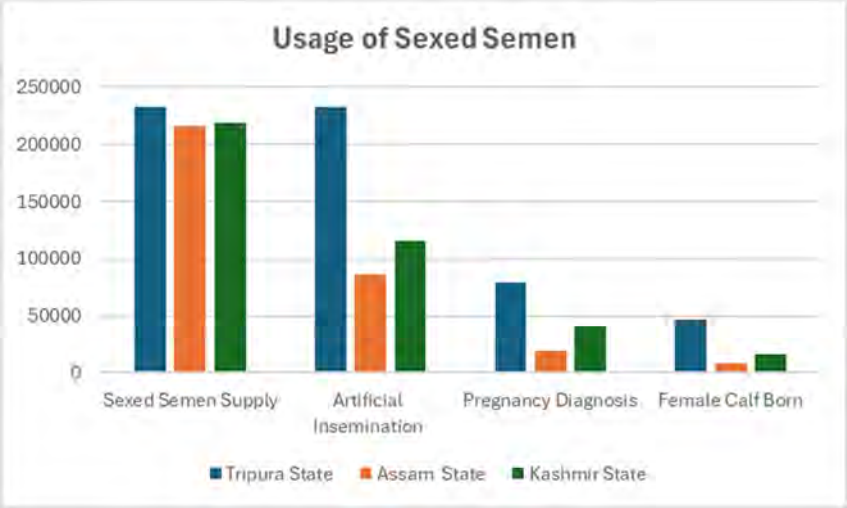
Performance reports from participating dairy farmers via monitoring and evaluation (M&E) formats.

Parameters assessed included AI conducted, pregnancy confirmation (PD), calf births, sex ratios, and milk yield from progeny. All data were triangulated to validate field effectiveness. The research covers diverse agro-climatic zones, enabling a comprehensive understanding of the biological and economic impact of sexed semen across different dairy ecosystems in India.

Results and discussion

The widespread deployment of Sexed Semen by ABS India across 13 Indian states has demonstrated remarkable on-ground impact, both in reproductive outcomes and economic gains. The technology's ability to significantly increase the proportion of female calf births has been validated through field implementation, especially under government-supported programs like the Rashtriya Gokul Mission (RGM).

One of the most compelling examples comes from Tripura state, where ABS India supplied 2.33 lakh sexed semen straws under a state breeding initiative. The field implementation resulted in over 79,628 confirmed pregnancies and 46,497 live births, with a scientifically verified female calf birth ratio of 90.1%. Similar success was recorded in Assam and Kashmir state, where 2,16,000 and 2,19,000 Sexed Semen dose were supplied respectively. With 86,000 AIs resulting in 19,000 confirmed pregnancies and 8,600 female calves born in Assam State. In Kashmir state, through DNA-based parentage verification has revealed 95.6% Female calf ratio.



In addition to biological outcomes, the program's effectiveness was amplified through capacity building. Over 13,000 AI technicians were trained in handling sexed semen protocols and assisted reproduction techniques. These technicians played a key role in ensuring optimal handling, timing, and post-insemination follow-ups, proven critical to achieving high conception rates.

Farmer-reported feedback indicated a noticeable improvement in milk yields and herd replacement rates, with many reporting an increase in income due to reduced male calf burden and enhanced productivity of female progeny. The cascading impact of higher female birth rates not only enhances the dairy economy but also aligns with national goals of breed improvement, nutritional security, and income doubling for farmers.

Economic and socio-technical impact

The economic implications of sexed semen technology in India's dairy sector are profound and multifaceted. A mere 1% increase in the usage of sexed semen can result in the birth of an estimated 900,000 additional female calves, which would translate into over 1.5 million metric tonnes (MMT) of additional milk annually. This increment alone can generate nearly ₹ 3,000 crore in added income for dairy farmers across the country. These figures underscore the transformative potential of this biotechnology not just in terms of reproductive control, but as a driver of income enhancement, food security, and national productivity.

At the socio-technical level, the benefits are equally compelling. The targeted birth of female calves leads to more efficient herd replacement, greater lifetime productivity, and reduced feed and maintenance costs associated with unproductive male calves. This directly contributes to improving farm economics, particularly for small and marginal farmers.

Moreover, the technology plays a pivotal role in empowering women dairy farmers, who traditionally oversee livestock care and milking in Indian households. By ensuring more productive animals, sexed semen contributes to higher and more stable household incomes, nutritional security, and asset creation for rural families. Importantly, the deployment of this innovation aligns with the goals of the National Dairy Plan, the Rashtriya Gokul Mission, and India's broader agenda for rural transformation and livestock genetic improvement.

Twin female calf born by using ABS Sexed Semen

Conclusion

The experience of ABS India in pioneering and scaling Sexed Semen Technology across the country has clearly demonstrated its transformative potential in reshaping India's dairy genetics. By enabling a higher probability of female calf births, this innovation directly addresses one of the most significant bottlenecks in dairy productivity. An imbalance in the gender ratio of calves. The deployment of Sexed Semen has led to improved herd replacement, increased milk output, and higher economic returns for Indian Dairy Farmers, particularly in states like Jammu & Kashmir, Tripura, Assam, Punjab, Gujarat, Uttar Pradesh, Maharashtra, Karnataka, Bihar, Odisha, Andhra Pradesh, West Bengal, Sikkim and Nagaland.

Success in this initiative has been driven not only by technological infrastructure and genetic resources but also by robust partnerships with government institutions, cooperative networks, and a trained field force of over 13,000 AI technicians. With continued investments in laboratory capacity, AI delivery systems, and rural awareness; Sexed Semen can emerge as a cornerstone technology in India's livestock development strategy.

Moving forward, strategic expansion, inclusive outreach, and adaptive research will be essential to mainstream this innovation, thereby supporting long-term goals of food security, farmer income growth, and sustainable dairy development under national programs like the National Dairy Plan and the Rashtriya Gokul Mission.

Acknowledgements

We thank Government of India, NDDB, ABS Global, ABS India, BG Chitale Dairy, ICAR, State Livestock Departments, Veterinary Universities & Institutes, Dairy Cooperatives & Federations, AI technicians, and dairy farmers whose collaboration made this progress possible.

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