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Sandeep Goyal

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Chairman, NDDB

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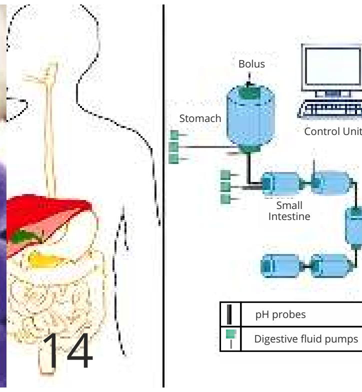

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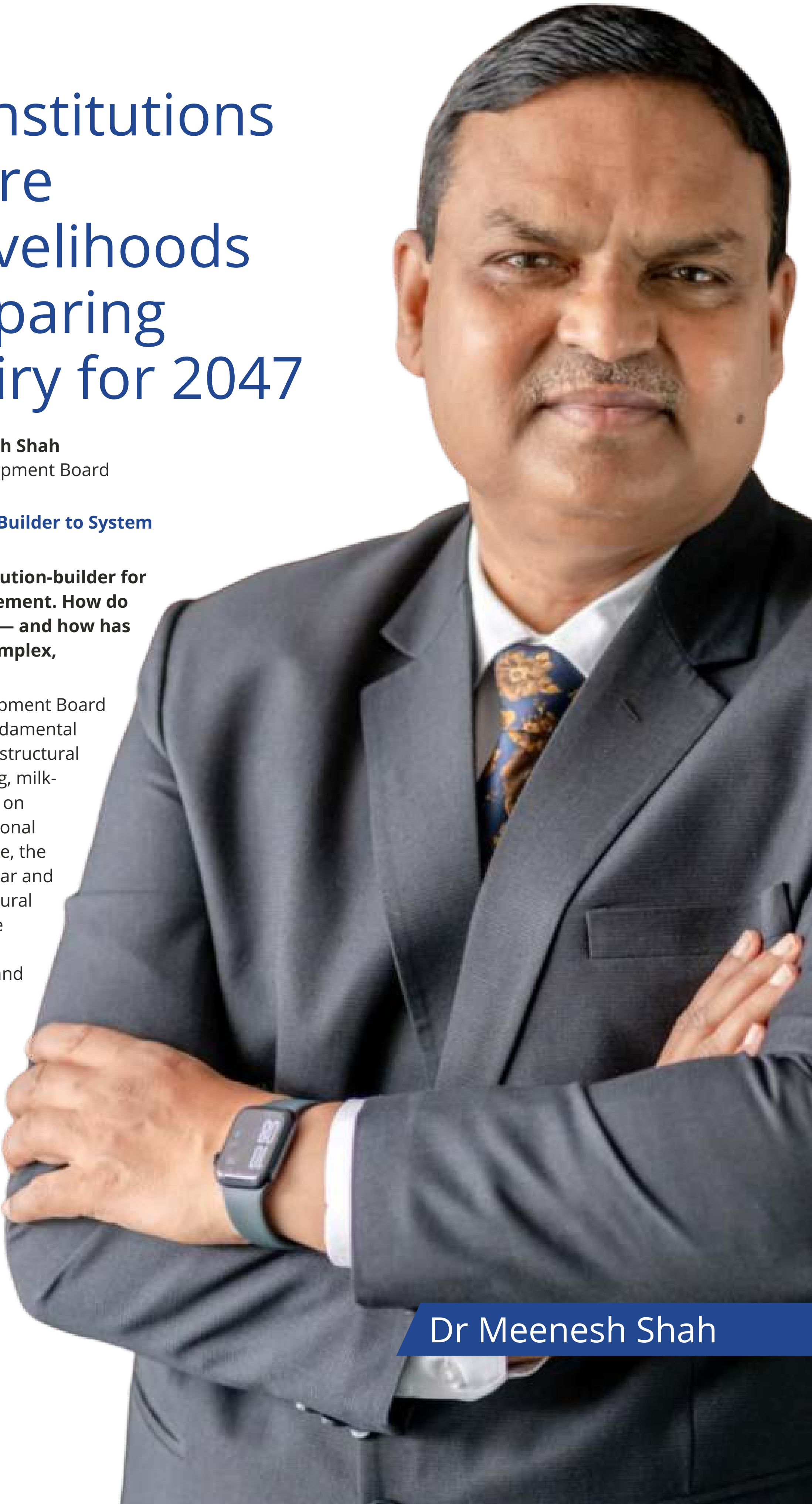
Building Institutions That Secure Farmer Livelihoods While Preparing Indian Dairy for 2047

In Conversation with **Dr Meenesh Shah**
Chairman, National Dairy Development Board



I. NDDB's Evolving Role: From Builder to System Steward

NDDB was created as an institution-builder for India's cooperative dairy movement. How do you define NDDB's role today — and how has that role evolved in a more complex, competitive dairy ecosystem?

When the National Dairy Development Board (NDDB) was established, the fundamental challenge confronting India was structural scarcity of milk. We were a young, milk-deficit nation heavily dependent on imports to meet the basic nutritional needs of our citizens. At that time, the institutional objective was singular and exceptionally clear: to organize rural producers, eliminate exploitative intermediaries, and ensure remunerative returns for small and marginal farmers. Under the visionary leadership of NDDB's founder Chairman Dr. Verghese Kurien, Operation Flood achieved this mandate with remarkable success making the nation self-sufficient or Atmanirbhar in milk.

However, the India of today is fundamentally different. We are no longer managing scarcity; we are managing abundance and aiming to make our mark on the global dairy trade. India has emerged as the largest milk producer globally, contributing an astounding 25 percent to the global milk output. The dairy sector has been growing rapidly and has become highly diversified, technologically advanced and intensely competitive. In this profoundly transformed context, NDDB's role has organically evolved from being primarily an "institution builder" to becoming an "ecosystem architect".

From Volume Expansion to Value Optimization: Our responsibility now goes beyond just establishing village-level societies. We must strengthen governance within cooperatives, improve professional management, incorporate digital transparency across the value chain, enhance dairy plant utilization, and align the sector's rapid growth with environmental sustainability. Vision 2047 demands that we meticulously guide the sector's transition from volume expansion to value optimization, from reliance on subsidies to structural competitiveness and from incremental productivity gains to significant, science-driven transformation.

Currently, NDDB is at the forefront of dairy science and technology. We are spearheading initiatives in genomics, accelerated breeding, sex-sorted semen, precision nutrition, digital milk procurement systems, circular economy initiatives converting dung to energy and organic fertilizers and ERP-enabled traceability systems. The next phase of dairy development must seamlessly blend productivity, profitability and environmental responsibility. This serves as the guiding principle for NDDB's strategic direction towards 2047.

Revitalizing and Handholding Institutions: A critical aspect of our evolved role is stepping in to rebuild and revitalize cooperative institutions that face structural or governance challenges. We acknowledge that cooperatives remain one of the best developmental models for a perishable commodity like milk.

In 2023, GoI approved Plan to strengthen the cooperative movement in the country and deepen its reach up to the grassroots, through establishment of new Multipurpose Primary Agricultural Credit Societies (M-PACS), Dairy and Fishery Cooperative Societies covering all the Panchayats/ villages in the country, with the support of NABARD, NDDB and National Fisheries Development Board (NFDB), through convergence of various existing schemes. For dairy sector, about 1.2 lakh Dairy Cooperative Societies (DCS) will be established and strengthened under White Revolution 2.0.

For expanding the coverage of dairy cooperatives, NDDB is actively managing and supporting various State federations and unions based on their specific needs, deploying our expertise and dedicated manpower to initiate turnarounds. Currently, we are involved in managing operations in West Assam Milk Union (WAMUL) and East Assam Milk Union (EAMUL) in Assam, the Jharkhand Milk Federation, Madhya Pradesh Cooperative Dairy Federation (MPCDF), Chhattisgarh Milk Federation, Mahananda Federation in Maharashtra, Varanasi Milk Union in Uttar Pradesh, Ladakh UT Federation, and Manipur Milk Union, among others. Through these direct interventions, we safeguard livelihoods of farmers, ensure timely payments and rebuild trust in the cooperative ethos. This ensures that viable producer-owned institutions are not lost due to short-term difficulties.

Ultimately, NDDB's role today is not just about expanding the cooperative footprint; it is about future-proofing the entire Indian dairy ecosystem. This is to ensure that our 80 million rural dairy households remain economically resilient and also globally competitive.

Indian dairy today includes cooperatives, private processors, startups and global players. How does NDDB balance cooperative principles with the need to remain relevant in a diversified market structure?

As the world's largest milk producing nation, we are also the biggest consumers of milk globally. This means there is room for everyone in the industry. India's dairy ecosystem is now a vibrant and diverse landscape, including cooperatives, private enterprises, innovative agri-tech startups and multinational players. I firmly believe that this diversity is not a weakness but a clear sign of sectoral maturity. The more players involved, the better it is for our farmers and consumers. India's dairy future will be most successful with a philosophy of coexistence and collaboration, rather than pure, cut-throat competition.

The Unique Strength of the Cooperative Anchor: Despite the market diversifying, the cooperative model continues to be uniquely suited to India's socio-economic structure. In our cooperative system, farmers are not just mere suppliers of raw materials; they are the owners of the enterprise. This structural distinction ensures that in many of our cooperative systems, producers receive an unprecedented 75 to 80 percent of the consumer rupee—among the highest shares globally. Cooperatives anchor farmer ownership, broad-based inclusiveness, and year-round economic stability, particularly for the landless and marginal farmers who form the backbone of our agrarian economy.

However, we are keenly aware that cooperatives cannot remain stagnant in a rapidly modernizing world. To stay relevant and robust, they require immediate and continuous governance reforms, stringent digital accountability, financial discipline and aggressive brand modernization. Through our Vision 2047 roadmap, we are dedicated to strengthening institutional professionalism while steadfastly preserving the democratic ownership that sets us apart.

Creating a Level Playing Field: We welcome the presence of private dairies and startups. The private sector often brings agility, deep capital, and rapid market innovation. In fact, if you look closely at the private dairies that have achieved significant scale and lasting success in India, they are the ones that have fundamentally adopted and mirrored cooperative principles in their farmer dealings.

When both cooperatives and private entities operate within a fair, transparent, and rule-based ecosystem, they can complement each other. They can share infrastructure, accelerate technology adoption, elevate national quality standards, and aggressively expand the market. Today, NDDB's mandate extends beyond cooperatives alone; we act in the interest of the entire dairy sector. Our goal is to ensure that every stakeholder competes strictly on merit, thereby encouraging a level playing field. Competition must undoubtedly drive efficiency, but farmer welfare must remain centric and entirely non-negotiable.

The Role of Startups and Innovation: We are also highly encouraged by the wave of new dairy and agri-tech startups emerging across the country. Companies and platforms focusing on digital technologies, data analytics, IoT, AI, and sustainable fodder solutions are proving that modern technology can deeply strengthen the entire dairy ecosystem. By fostering an environment where cooperatives can partner with these agile startups, we ensure that the traditional values of the dairy movement seamlessly merge with the technological demands of the 21st century. Ultimately, India is a vast, growing market with ample scope for both cooperatives and private players to flourish together, learning from each other while collectively elevating the prosperity of the Indian farmer.

II. Institutional Impact & What Has Changed on the Ground

Over the last few years, NDDB has worked across milk procurement, breed improvement, input services, quality systems and market access. Which interventions do you believe have created the most lasting impact at the farmer level?

When we evaluate impact in agriculture, success cannot be measured in quarterly outcomes; it must be measured in generational impact. Over the past decade, NDDB has deployed a multi-pronged strategy to enhance farmer livelihoods. While all our interventions are highly interconnected, three specific areas have triggered the most profound and lasting transformation at the grassroots level: Scientific Breed Improvement, Sustainability & Circularity in the dairy sector, and Digitalization.

"The past 7 decades of India's dairy journey have been defined by scale, inclusivity, and resilience. The next phase will hinge on efficiency, innovation, sustainability..."

a) Science-Led Breed Improvement: The most powerful lever for farmer income enhancement is productivity per animal, that is more milk per animal, while not expanding herd sizes. We have democratized access to cutting-edge advance reproductive technologies that were previously out of reach for marginal farmers.

- Genomic Chips: We developed indigenous genotyping chips—GAUCHIP for cattle and MAHISHCHIP for buffalo—which enable affordable early selection of high-quality heifers and bulls.
- Sex-Sorted Semen (GauSort): We introduced indigenous sex-sorting technology that ensures 90 percent female calf births at one-third of the earlier cost. This directly addresses the economic burden of unproductive male calves and accelerates the genetic potential of the herd.
- Reproductive Technology: Reproductive technologies such as Ovum Pick-Up, In Vitro Embryo Production, and Embryo Transfer (OPU–IVEP–ET) were propagated through a hub-and-spoke model. Also, our indigenous IVF media suite, 'Shashthi', supports cost-effective in-vitro embryo production, reducing dependence on expensive imported media.

NDDB is advancing its productivity enhancement initiatives by adopting a three-pronged strategy that integrates scientific breeding, balanced nutrition, and improved animal management practices.

b) Sustainability and Circularity – Manure Value Chain: Perhaps our most ecologically and economically transformative intervention recently has been the promotion of the manure value chain. The dairy industry globally faces intense scrutiny for methane emissions. The Biogas models developed for the dairy sector —viz. the Decentralized model (Zakariyapura Model), Centralized model (Varanasi Model) and Compressed Biogas model (Banas Model)—turn animal waste into wealth.

We have facilitated the installation of over 80,000 household-level flexi-biogas plants. These decentralized units provide rural women with clean cooking fuel (reducing dependence on firewood) and generate nutrient-rich bio-slurry that acts as a potent organic fertilizer. This drastically reduces the farmer's expenditure on chemical fertilizers, improves yield of crops by about 20% and promotes organic farming. By linking manure management with renewable energy, we are creating a climate-responsible dairy sector while simultaneously opening up a brand-new, non-milk income stream for the farmers.

Under the centralized model, currently implemented at Varanasi Milk Union, cattle dung is procured from farmers and gaushalas located within a radius of approximately 10–15 kilometres from the dairy plant. The collected biomass is utilized for biogas production, which is used as a substitute for light diesel oil (LDO) in the plant's boiler operations and to meet the electricity needs of the plant. This initiative has resulted in a reduction in milk processing costs. The digestate (slurry) generated as a by-product is processed into organic fertilizers and marketed to farmers.

Under the Compressed Biogas model (Banas Model), cattle dung collected from farmers is processed into bio-CNG at an industrial scale, which is chemically and functionally equivalent to conventional compressed natural gas (CNG). The bio-CNG is distributed through retail dispensing outlets for use as an automotive fuel. NDDB has partnered with Suzuki R & D Center India (SRDI) to promote and scale up this model by facilitating tie-ups with dairy cooperatives across the country for the organized collection of cattle dung, production of CBG and dung-based fertilizers. Three (3) such Compressed Biogas plants have already been established and further seven (7) CBG plants are being taken up under NDDB-SRDI partnership.

c) **Digitalization:** The most immediate pain point for a smallholder farmer is opaque testing and delayed payments. Our aggressive push toward digitalization has fundamentally resolved this issue. The deployment of Data Processor Milk Collection Unit (DPMCU)/Automatic Milk Collection Systems (AMCS) at the village level ensures absolute transparency and fairness in milk fat and SNF (Solid Not Fat) testing. When farmers see their milk tested digitally and receive real-time, accurate payments directly into their bank accounts, it builds an unshakeable bedrock of trust.

Furthermore, the Bharat Pashudhan platform, developed in collaboration with the Department of Animal Husbandry and Dairying (DAHD) under the National Digital Livestock Mission (NDLM), is revolutionizing how we interact with farmers. By providing a digital identity i.e., Pashu Aadhaar to dairy animals, the Bharat Pashudhan platform enables real-time tracking of health, breeding, and productivity stages/activities. It transitions the Indian dairy sector from being merely scale-driven to being deeply data-driven, empowering farmers to manage their herds as informed agri-entrepreneurs. Ration balancing and other dairy farmer advisory services have been scaled through the 1962 Farmers App.

What lessons has NDDB learned recently about what does not work anymore in dairy development, even if it worked well in the past?

Institution building is an iterative process, and acknowledging what no longer works is just as critical as pioneering new strategies. The earlier phases of India's dairy expansion were rightfully focused on scale and volume. However, one of the most profound lessons we have learned is that procurement growth without simultaneous productivity enhancement creates a systemic imbalance. In the past, India achieved milk production growth largely by adding dairy animals. Today, this is no longer ecologically or economically viable. Increasing animal numbers put unsustainable pressure on our limited land and water resources, and directly impacts the profitability of the farmer. We now know that India's dairy future will be determined entirely by improving genetic potential and feed efficiency, not by merely adding more animals to the system.

Another critical lesson revolves around institutional support and governance. In the past, it was often assumed that financial subsidies alone could uplift struggling dairy cooperatives. However, experience has categorically shown that subsidies without governance reform only weaken institutions in the long run. Pumping capital into a cooperative that lacks professional management or digital transparency does not yield sustainable results. We have learned that cooperatives can no longer be viewed merely as vehicles for rural development or administrative deployment; they must operate as competitive business entities to truly serve their members. Market focus is essential and non-negotiable because if one cannot market whatever is being procured, it becomes extremely difficult to survive.

Furthermore, we have realized that incremental productivity gains are no longer sufficient to keep pace with global markets and rising domestic input costs. The era of basic extension services has passed. Today, technology adoption must be field-responsive, policies must be evidence-based, and the transformation must be science-driven. Providing generic advice is no longer effective; interventions must be highly targeted, such as using indigenous genomic chips for early selection of high-quality heifers, or deploying precision ration balancing tailored to individual animals. In short, the "volume-at-any-cost" and "subsidy-first" approaches of the 20th century have been replaced by a mandate for integrated development, where productivity, sustainability, and institutional integrity must advance together.

III. Farmer Economics at the Core

Farmer income stability is under pressure from climate stress, rising input costs and price volatility. How does NDDB view the next phase of dairy farmer economics in India?

The economic landscape for the Indian dairy farmer is undeniably becoming more complex. Dairy farmers face an escalating triad of challenges: rising feed costs, climate variability, and global market volatility. When you consider that approximately 70 percent of milk production costs go directly toward animal feeding, any fluctuation in fodder or feed prices severely impacts the farmer's bottom line. Therefore, NDDB's view on the next phase of dairy economics requires a paradigm shift: our future strategies must prioritize income stability over mere output growth.

We are engineering this income stability through a two-pronged approach: relentlessly driving down the cost of production and creating parallel, non-milk income streams. To reduce production costs, we are promoting Ration Balancing Programme (RBP), precision nutrition and alternative healthcare. Through the use of bypass proteins, Total Mixed Ration (TMR), and the 1962 Farmers App for ration balancing, we optimize feed efficiency so the farmer gets more milk per rupee spent on feed. Furthermore, we are actively promoting Ethno-Veterinary Medicine (EVM)—an Ayurveda-based alternative therapy model. EVM enables timely treatment of common animal ailments with minimal cost, drastically lowering veterinary expenses and reducing antimicrobial resistance, which improves animal longevity and productivity.

The second prong involves creating resilient parallel income streams, primarily through the circular economy and value addition. We are teaching farmers to view dairy waste as a secondary cash crop. NDDB's biogas models turn dung into clean cooking fuel and nutrient-rich organic fertilizer. This entirely eliminates need for the farmers to purchase chemical fertilizers or traditional cooking fuels, while surplus slurry can be sold for additional income.

On the market side, the economics of stability requires a shift from selling raw liquid milk to Value-Added Products (VAPs). By diversifying into modern VAPs, cheese, whey derivatives, and probiotic beverages, protein rich dairy products cooperatives can cater to evolving consumer demands and secure higher profits. Furthermore, with the establishment of the National Cooperative Organics Limited (NCOL), we are providing institutional support for farmers to pivot to organic dairy and agriculture, which fetches premium prices under the "Bharat Organics" brand. By 2047, through these integrated economic models, dairying must be firmly established as a highly stable, aspirational, and climate-resilient livelihood.

When you look at smallholder farmers today, what are the most significant structural vulnerabilities that still concern you, and where can institutions realistically make the most significant difference?

The Indian dairy sector is primarily a smallholder ecosystem. While this decentralized model is our greatest strength, it inherently exposes our farmers to significant structural vulnerabilities such as highly limited landholdings, severe exposure to climate risks, and deeply fragmented market access.

My main concern is that approximately 65 percent of the milk surplus in India is still handled by unorganized markets. In this unorganized space, smallholders lack quality testing, traceability, and remunerative returns. They operate without a safety net, leaving them vulnerable to price manipulation and sudden market shocks.

Institutions are essential for mitigating these massive, systemic risks. Organized procurement systems, breeding services, veterinary outreach, and digital payment frameworks ensure absolute stability and trust where individual farmers are vulnerable. When NDDB or a State cooperative enters a village, they not only buy milk but also establish an institutional ecosystem.

Guided by the vision of "Sahkar-se-Samriddhi" - prosperity through cooperation, NDDB has embarked on an ambitious mission to reach out to more and more and dairy farmers. The cooperative-led "White Revolution 2.0" is aimed at expanding cooperative coverage, employment generation, and women's empowerment by providing market access to dairy farmers in uncovered areas and increasing the share of dairy cooperatives in organized sector. NDDB has been designated as a principal stakeholder in the implementation of this national initiative.

An action plan has been prepared and rolled out by NDDB for establishing about 75,000 new Multipurpose DCS (MDCS) during 2024-25 to 2028-29 to achieve the procurement targets. In addition, over 46,000 existing village-level DCS/PACS will be strengthened with better and advanced milk procurement and testing infrastructure. We are making good progress on this mammoth assignment as the goal is to achieve in 5 years what was done in the past 75 years.

Also, to address these structural gaps on a national scale, NDDB has led the creation of three new Multi-State Cooperative Societies.

- To address the vulnerability of rising input costs, Cooperative Input Service Delivery Multi-State Limited (CISDL) is established which integrates feed, fodder, and breeding solutions to reduce costs and improve farm-level profitability.
- To address climate vulnerability and livelihood resilience, the Gomay Sahkari Samiti Multi-State Limited (GSSL) is established, focusing on scientific manure management and renewable energy.
- To address market fragmentation, the Cooperative Milk Producers' Organization Multi-State Limited (CMPOL) is envisioned to aggregate scale and enhance market access across states, ensuring farmers receive a fair share of the consumer value.

Another glaring structural vulnerability is the risk of generational attrition—the potential lack of interest of rural youth in traditional farming. Institutions must intervene realistically by fully modernizing the sector. By integrating technology, forming startup partnerships, and deploying digital platforms like Bharat Pashudhan, we are transforming dairy farmers from subsistence producers into informed, tech-savvy agri-entrepreneurs.

Making dairy farming an aspirational, knowledge-driven enterprise is the ultimate institutional intervention to ensure generational continuity and protect the future of smallholders .

IV. Quality, Productivity & Competitiveness

Quality, traceability and productivity are increasingly critical for dairy competitiveness. How is NDDB helping shift the sector from a volume-led mindset to a value- and quality-led one?

For decades, the Indian dairy industry focused on increasing volume to meet the needs of a growing population. Now, as the world's largest producer, sometime down the line the focus was shifted towards what I refer to as the "Value and Quality Era." In a global market, having both volume and quality is a powerful advantage.

NDDB is leading this transformation through a comprehensive "Cow to Consumer" quality framework. The first component is Digital Traceability. Through the National Digital Livestock Mission (NDLM), we are establishing a clear digital trail. When a consumer in a city or an importer in a foreign country purchases a dairy product, they would be able to trace its origins back to a group of villages where animal health and vaccination records are digitally verified. This transparency is crucial in modern dairy trade.

Additionally, we are promoting quality through the Quality Mark and the Conformity Assessment Scheme (CAS). Developed in partnership with the Bureau of Indian Standards (BIS), this certification is tailored for the dairy industry. It goes beyond just the final product to assess the entire management system of the dairy plant and primary society.

Finally, the dairy cooperatives are shifting the focus to Value-Added Products (VAP). Liquid milk is a commodity with slim margins. The true value for the farmer lies in converting milk into cheese, high-quality butter, paneer, and functional foods like probiotics, protein-rich or fortified milk. NDDB is providing the technical expertise and financial support to cooperatives to upgrade their processing infrastructure. By moving up the value chain, we ensure that the "value-led" mindset results in actual "value-retention" at the farm gate.

Do you believe India can achieve higher productivity and quality without compromising inclusiveness? What trade-offs must the sector consciously manage?

This is perhaps the most critical question facing the Indian dairy movement today. In the Western model, productivity is often achieved through "economies of scale"—large, mechanized farms with thousands of cows, whereas unproductive cows are readily culled for beef. In India, our model is "production by the masses," not "mass production" and we revere our cattle and treat it as a family member.

I firmly believe that productivity and inclusiveness are not mutually exclusive; however, they require a uniquely Indian approach. We cannot simply import Western mega-farm technologies; we must "Indianize" them for the smallholders. For example, instead of a robotic milker for a 1,000-cow farm, we can deploy Community Milking Parlours at the village level where 200 farmers can bring their 2 cows each to be milked under hygienic, standardized conditions. This achieves "industrial-grade" quality while preserving "smallholder-grade" ownership.

Managing the Trade-offs

The primary trade-off we must manage is the cost of technology versus the ability of the small farmer to pay. If sex-sorted semen or genomic selection remains expensive, it will only benefit the wealthy farmers, leading to an "equity gap" in rural India. NDDB's role is to act as a market stabilizer. By developing indigenous technologies like the GAUCHIP and GauSort, we have driven down the cost of innovation so that the smallest farmer can access the same genetic progress as a large-scale operator.

Another trade-off is between traditional practices and modern standards. As we move toward stricter quality norms, some smallholders may find compliance difficult. Here, the cooperative acts as the buffer. The cooperative takes on the burden of compliance, testing, and cold-chain logistics, allowing the farmer to focus on animal husbandry while still participating in a high-value, modern market. Our goal for 2047 is an "Incentivized Quality" model, where the farmer is rewarded with a price premium for higher quality, ensuring that inclusiveness is driven by economic and social empowerment.

V. Dairy Vision 2047: The Long Arc

As India looks towards Dairy Vision 2047, what are the three most critical structural shifts the sector must make to remain farmer-centric while being globally competitive?

To navigate the next two decades, I see three non-negotiable structural shifts:

a) From Milk-Centric to Livestock-Centric Economy: We must stop viewing the cow or buffalo merely as a "milk machine." These animals are a biological asset that produces milk, manure, and energy. By fully operationalizing the Manure Value Chain, we transform the economics of the dairy farming. When a farmer earns from both milk and bio-slurry/biogas, their resilience against milk price fluctuations increases exponentially. This is the ultimate "Farmer-Centric" safeguard.

b) Total Genetic Transformation via Genomics: We cannot reach 2047 with our current average productivity levels. We need a "Genetic Leapfrog." This involves transitioning from traditional breeding to shifting to genomic-led selection, high quality AI, IVF technologies and sex-sorted semen technology.

c) Share of Organised Sector: Presently, Indian dairy sector is dominated by unorganised sector, which poses challenges pertaining to quality, hygiene and adulteration of milk. The only way to address these issues is to increase the share of organised sector in surplus milk handling. Presently, about two-third quantity of surplus milk is flowing through unorganised channel, whereas only one-third by organised players like dairy cooperatives and private players. We need to reverse this scenario. White Revolution 2.0 is one such step towards providing market access to more and more dairy farmers in the country. Going forward, we need to cover all milk potential villages in the country under the ambit of organised sector.

By 2047, how do you see India positioning itself globally — as a dairy exporter, a technology leader, or a model for inclusive food systems?

By 2047, India will embody all three identities, without having to choose between them. Our greatest contribution will be as a Global Model for Inclusive Food Systems.

While we will certainly be a major Dairy Exporter—leveraging our geographical proximity to milk-deficit regions in the Middle East and SE Asia & other geographies and a Technology Leader. Our true "soft power" lies in our model. Much of the developing world in Africa and Asia mirrors India's smallholder structure. They are looking for a way to achieve food security without displacing millions of rural families.

India will serve as the proof of concept that you can be the world's largest dairy producer while keeping the "small farmer" at the centre of the story. We will be the global hub for "Frugal Innovation" in dairy—showing the World how to use digital IDs, low-cost sex-sorted semen, and decentralized biogas to create a profitable, carbon-neutral, and socially-equitable dairy ecosystem.

VI. The Next Five Years: NDDB's Strategic Priorities

Looking ahead to the next five years, what would you like NDDB to be known for when we look back at this phase of its journey?

In the next five years, I want NDDB to be remembered as the institution that "Digitalized the Soul of Indian Dairying." We are currently in the middle of a massive institutional outreach programme. Through White Revolution 2.0, we are expanding into 75,000 new villages. In five years from now, we would have successfully created a "Digital Spine" (through NDLM) that connects these millions of new dairy farmers to transparent markets, while simultaneously scaling the "Manure-to-Wealth" model. I want NDDB to be seen not just as a policy executor, but as a high-tech partner to the Indian dairy farmer—the bridge between the rural cowshed and the global consumer.

VII. Leadership & Legacy

Having spent decades in institution-building, what leadership principles guide you today, and what advice would you give to the next generation of leaders shaping India's dairy and food systems?

My leadership philosophy is built on three pillars: Integrity, Grassroots Empathy, and Data-Driven Decision Making.

In the cooperative sector, Integrity is your only currency. You are handling the hard-earned money of millions of farmers; any breach of trust is a systemic failure. Secondly, you must have Grassroots Empathy. You cannot lead the dairy sector from a glass office in a city. You must understand the smell of the cowshed, the worry of a farmer when a calf falls ill, and the joy of a woman receiving her first milk cheque.

My advice to the next generation is this: Combine a "High-Tech" head with Farmer Welfare approach. Use the best technology, the best genomics, and the best data analytics, but always ask yourself: "How does this help the woman standing at the end of the queue in a village at the dairy cooperative society (DCS)?" If your technology doesn't solve her problem, it isn't the right technology for India.

If you had to advise your younger self, coming fresh out of college, what would it be?

I would tell my younger self: "“Success in dairy sector is not a solo journey; it is a lesson in the power of the collective.”

When I started 40 years ago, I understood that this conviction shaped not only the cooperative movement in India, but also my own journey. I soon realized that in rural India, change moves at the pace of trust. You have to earn the right to innovate in a village. I would tell myself to listen more than I speak, as the knowledge you gain from farmers cannot be taught through any book. Therefore, I would offer my younger self the same advice I give to those joining the organization today: remain open to learning and commit to understanding every dimension of the ecosystem you are entering.

I would also say: "Respect and appreciate the resilience of the Indian farmer." Through droughts, floods, and unforeseen circumstances such as COVID-19 pandemic, they have never stopped working. Thus, you need to remain committed to their welfare without stopping as well. The institutions you build with the same spirit will never fail.

Finally, I would remind myself that while we work with milk, we are actually in the business of Social and Economic Empowerment. Milk is just the medium; the transformation of a farmer's life is the real product.

Tips for managing Summer Stress in Dairy Animals

by **Dr T M Gowrisankar**- Independent Nutritionist and Animal feed consultant

Dr T M Gowrisankar

Hot ambient temperatures have a significant impact on the productive and reproductive performance of dairy cows and buffaloes. In India, the period from 1 March to 15 June is typically characterized by intense summer heat, during which dairy animals are highly prone to heat stress. Crossbred cows such as HF and Jersey cross bred cows can tolerate temperatures up to 27–30°C. Beyond this range, milk yield, milk fat percentage, and milk SNF percentage are adversely affected due to heat stress.

Effects of Heat Stress on Dairy Cattle

Cattle are naturally less efficient at dissipating heat compared to humans. They sweat only about 10% as much as humans, making evaporative cooling essential. Key effects include:

- Reduced feed intake by 8–12% or more
- Decreased volatile fatty acid production in the rumen
- Reduction in milk yield, milk fat %, and SNF %
- Panting, which can increase maintenance energy requirements by up to 20%

- Elevated body temperature and respiration rate

Proper management practices are therefore essential to minimize the impact of summer stress.

Warning Signs of Heat Stress

If the following signs are observed, animals require immediate attention:

- Animals move toward shaded areas
- Increased water intake with reduced feed intake
- Preference for standing rather than lying down
- Rapid, shallow breathing
- Increased respiration rate and body temperature
- Excessive salivation
- Open-mouth panting
- Dull skin and red, hot eyes

Consequences of Summer Stress

Heat stress is generally more severe in crossbred cattle and buffaloes, while native breeds are comparatively more tolerant.

Major consequences include:

- 10–40% reduction in milk yield
- Decreased milk fat % and SNF %
- Reduced feed intake
- Increased somatic cell count and higher incidence of mastitis and environmental infections
- Decline in reproductive performance and conception rates
- Increased susceptibility to fever and metabolic disorders

Important Management Tips to Reduce Summer Stress

1. Provide Adequate Shade

Trees offer the most effective natural shade. If unavailable, construct thatched roofs with a minimum height of 9 feet. Additional cooling measures include:

- Covering shed roofs with coconut leaves, paddy straw, or grass
- Painting roofs with white paint or slaked lime (sunnambu)
- Installing false ceiling insulation
- Using wet gunny bags to cool overhead water tanks and pipelines

Barriers such as thatched walls or wet gunny cloth can reduce the impact of hot winds.

2. Feeding Management

Strategic feeding practices play a crucial role in minimizing the impact of heat stress on dairy animals. Since feed intake naturally declines during hot weather, careful planning of feeding schedules and ration composition is essential to maintain productivity.

Animals should be fed during the cooler parts of the day to encourage better intake and reduce metabolic heat production:

- Early morning: 4:00–6:00 a.m.
- Late evening/night: 9:00–11:00 p.m.
- Additional recommendations:
- Offer smaller quantities during daytime
- Increase cattle pellet feed by 1–2 kg per cow per day
- Provide high-quality green fodder, especially for early lactation cows
- Supplement sodium bicarbonate at 50–200 g per cow per day to maintain rumen pH
- Gradually adjust ration formulation before peak summer

Increasing feeding frequency and pushing up feed more often improves dry matter intake (DMI). Raising total mixed ration (TMR) moisture to 45–50% (from the typical 35–40%) enhances palatability and intake.

Increasing the energy density of the TMR is also an effective strategy when dry matter intake is reduced. Supplementing with protected fat is a practical and efficient method to increase energy intake without raising metabolic heat production.

Any changes in diet formulation and feeding procedures should be introduced gradually and preferably before the onset of peak summer. Planned nutritional adjustments, combined with proper feeding management, significantly reduce the adverse effects of heat stress and help sustain milk production during hot weather.

3. Ensure Adequate Water Supply

- Provide clean, cool drinking water throughout the day
- Ensure 24-hour access to water
- Cover overhead tanks and pipelines to maintain water temperature

Water is the most critical nutrient during summer.

4. Improve Ventilation and Cooling

- Install fans in sheds and feeding areas
- Use sprinklers or fine mist systems between 10 a.m. and 6 p.m.
- Spray animals with water during peak heat (12 p.m.–6 p.m.) and If sprayer is not available, take water in a bucket and pour it over the animal using a mug.
- Use wet gunny or jute bags (gunny cloth or Kithan sakku) over the body during extreme heat
- Run water over shed roofs for evaporative cooling

Cows cooled during the hottest part of the day often show improved evening milk yield.

5. Mineral and Nutritional Supplementation

During hot weather:

- Provide mineral mixture at 50 g per cow per day
- Increase potassium (1.5–1.6%), sodium (0.45–0.60%), and magnesium (0.35–0.40%) in rations
- Maintain protein at approximately 18%, with 37–39% rumen undegradable protein
- Provide yeast cultures (Aspergillus oryzae and Saccharomyces cerevisiae)
- Supplement vitamins A, D, and E
- Increase dietary energy density using supplemental fat
- Maintain ADF (minimum 19%) and NDF (minimum 28%) to prevent acidosis

6. Health and Sanitation

- Deworm animals regularly
- Disinfect sheds with appropriate acaricides in consultation with a veterinarian
- Improve sanitation and bedding management
- Schedule vaccinations during cooler hours
- Monitor animals closely, as heat stress suppresses immune function

Impact on Reproduction

Heat stress severely affects fertility:

- Delayed ovulation and reduced estrus expression
- Shortened heat duration (up to 50%)
- Reduced pregnancy rates as Temperature Humidity Index rises
- Increased embryo mortality when uterine temperature reaches approximately 104°F
- Decline in pregnancy rates when maximum air temperature exceeds 85°F

Embryos are particularly sensitive during the first one to two weeks after insemination. Cooling measures during this period are critical. Heat stress during the last 60–90 days of gestation may reduce calf birth weight and subsequent milk yield.

Conclusion

Heat stress affects milk production, reproduction, immunity, and overall profitability of dairy operations. However, through timely shade provision, improved ventilation, adequate nutrition, clean water supply, and careful reproductive management, dairy farmers can significantly reduce summer-related losses.

Proactive summer management is not an option—it is a necessity for sustaining productivity and herd health during India's hot season.


Image Source: ruminants

Subclinical Mastitis: A Hidden Challenge Affecting the Feed Mill

by **Gnanasekar (GS) Rangasamy**, Novus

In India's competitive dairy feed industry, feed mills invest heavily in formulating high-performance products to improve productivity. However, a largely unseen challenge—subclinical mastitis—can significantly influence how farmers perceive feed effectiveness.

While this condition shows no visible symptoms in dairy cows, it can result in reduced milk yield, lower productivity, and farmer dissatisfaction. These outcomes may affect how feed performance is perceived and ultimately impact feed sales, brand reputation, and customer loyalty.

What is Subclinical Mastitis?

Subclinical mastitis is an inflammation of the udder that is not detected through visual inspection.

- Milk appears normal, but somatic cell count (SCC), a key indicator of milk quality, is elevated.
- The condition often goes unnoticed for weeks.
- Milk yield losses may range from 5% to 25%, depending on infection severity, stage of lactation, and herd management practices.
- Elevated SCC can reduce milk processability for procurement companies. For example, high SCC can lower paneer yield and reduce the shelf life of milk products.

Subclinical mastitis is primarily a herd-level management challenge. Nutrition alone cannot prevent or cure the condition. However, appropriate nutrition can support immune function, tissue integrity, and overall cow health, thereby helping reduce the risk and severity of subclinical mastitis.

Prevalence in India

This condition affects 12–70% of lactating cows depending on farm hygiene, region, and herd size (Krishnamoorthy et al., 2021). These figures reflect industry-wide observations and are not linked to specific feed or nutrition programs.

As shown in image 1, subclinical mastitis is prevalent across all regions of India and represents a significant

Image 1: Map showing the incidences of subclinical and clinical mastitis by state.(Source: Research in Veterinary Science Volume 136, May 2021, Pages 561-586)

economic burden for farmers, as well as for the feed and dairy industries.

The Overlooked Challenge for Feed Mills

At first glance, a feed miller might not associate subclinical mastitis with feed performance. However, subclinical mastitis can influence how farmers evaluate their feed programs, especially when milk yield does not meet expectations.

When cows face health or management challenges, farmers may attribute reduced milk yield to feed quality—even when nutrition is not the root cause. This can undermine confidence in a feed brand and prompt farmers to explore alternative nutritional strategies, potentially affecting purchasing patterns and customer retention.

Because feed is closely linked to animal performance, variations caused by on-farm conditions, especially subclinical mastitis, can make it difficult for feed mills to demonstrate the true value of premium formulations. As a result, sales and technical support teams may spend more time addressing farmer concerns, reducing the time available for new business development.

Economic Impact for a 1,000 MT Feed Mill (Monthly)

Consider a feed mill producing 1,000 metric tons of feed per month. Assuming an average consumption of 5 kg per cow per day, this volume supports approximately 6,500 cows monthly.

If 30% of these cows consume 0.5 kg less feed per day due to subclinical mastitis, the mill would lose approximately 30 metric tons of feed sales per month, nearly 3% of total production. This represents lost opportunity within the existing customer base.

At an assumed feed price of INR 25 per kg, this equates to a potential monthly revenue loss of approximately INR 7 lakh.

What Can Feed Mills Do?

Feed mills seeking to maintain customer satisfaction and support udder health have several options.

1. Optimize Nutritional Strategies

Micronutrients, particularly trace minerals can play an important role in supporting immune function and tissue integrity. However, not all mineral sources are equal.

Highly bioavailable trace minerals should be prioritized. Bis-chelated organic trace minerals have demonstrated superior absorption compared to inorganic forms, ensuring that a greater proportion of supplemented minerals is utilized by the cow.

2. Support Farmer Education

Feed mills serve a diverse customer base, and not all farmers may be fully aware of the management factors that influence udder health, milk yield, and overall dairy performance.

Providing guidance on:

- Udder hygiene best practices
- Proper milking routines
- Monitoring SCC trends
- Understanding the role of micronutrients in cow performance

can strengthen farmer knowledge while enhancing the mill's credibility and advisory role.

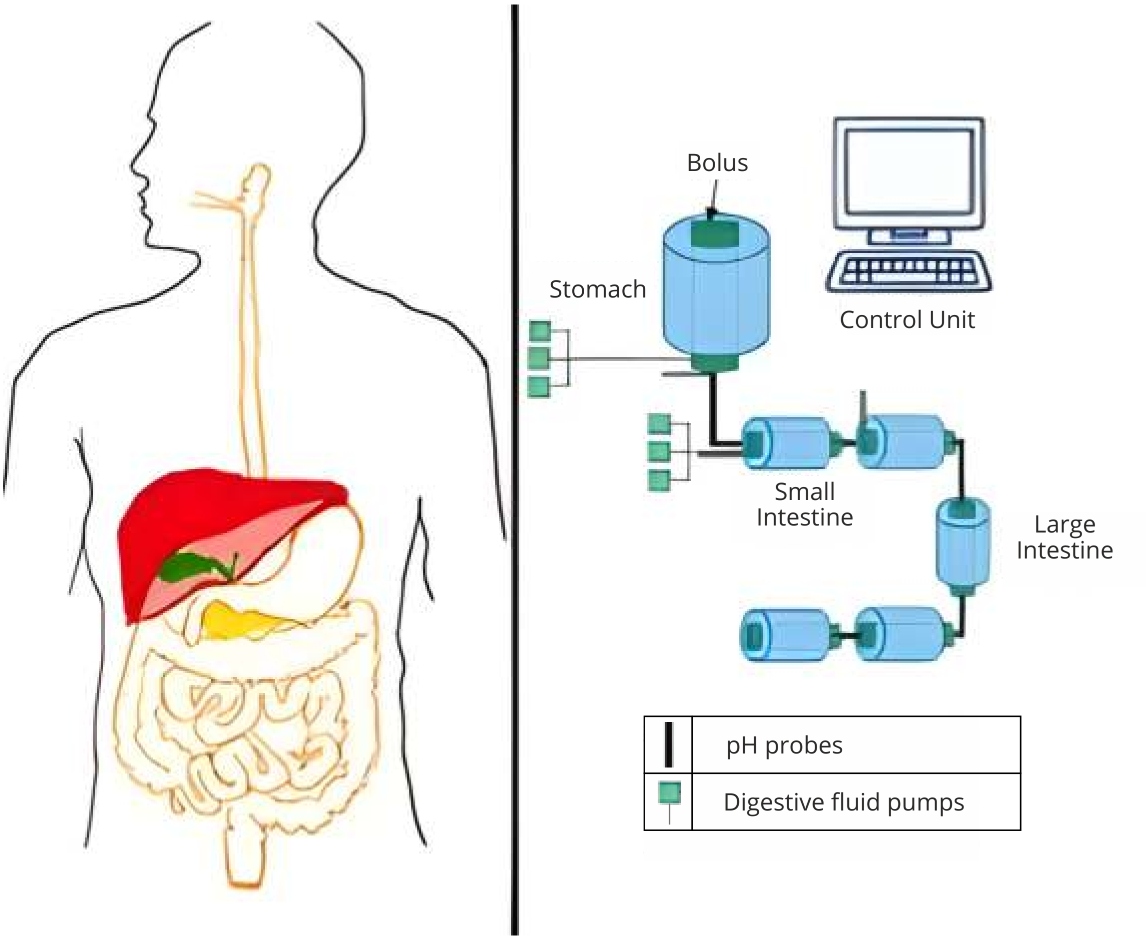
3. Encourage Herd-Level Monitoring

Promoting regular SCC testing and subclinical mastitis screening as part of herd health management allows farmers to evaluate feed programs alongside on-farm practices. This ensures a more complete and accurate understanding of cow performance.

Conclusion

By supporting farmers with practical information, management insights, and consistent nutritional programs, feed mills can strengthen customer relationships, reinforce brand trust, and protect business performance against challenges that may otherwise be misattributed to feed quality.

References are available upon request



Simulating Digestion to Personalise Satiety: The Future of Fiber-Enriched Foods

by **Swati Sangolgi and Sundram Singh**,
Master's (Animal Biochemistry), ICAR-National Dairy Research Institute, Karnal

Abstract

Satiety is not determined solely by calorie intake; rather, it is governed by a complex interplay among food structure, digestive processes, and hormonal signals that regulate appetite. The development of the INFOGEST standardized in vitro digestion protocol has enabled researchers to simulate human digestion in laboratory settings with remarkable precision. This advancement is particularly significant for studying how combinations of dietary fibers and proteins can be engineered and processed to optimize satiety.

INFOGEST-based research offers a controlled and detailed understanding of how food structures influence fullness and metabolic responses. These insights are paving the way for the development of functional foods that not only enhance satiety but also promote improved metabolic health, marking a substantial advancement in nutritional science.

Introduction

Certain foods keep us feeling full longer than others, even when they contain similar calorie counts. This phenomenon highlights that satiety is not merely a matter of energy intake; it is deeply influenced by how nutrients are digested and absorbed. The breakdown of specific nutrients stimulates the release of satiety hormones and modulates hunger signals over time.

Advanced in vitro digestion models such as INFOGEST allow researchers to examine, in detail, how fibers and proteins behave during digestion. These tools provide new insights into the mechanisms underlying appetite control and nutrient metabolism.

INFOGEST in Action: Revealing the Metabolic Pathways of Satiety

The true value of INFOGEST protocols lies in their ability to clarify the metabolic processes triggered by diverse dietary components. During digestion, fibers and proteins are broken down into bioactive peptides, short-chain fatty acids, and other metabolites. These compounds actively influence metabolic pathways, including energy expenditure, insulin sensitivity, and the secretion of appetite-regulating hormones.

The incorporation of viscous or gelling fibers into milk-based foods has been shown to slow protein hydrolysis and modify the bioactive peptide profile generated during digestion. This modulation promotes sustained activation of gut hormones such as GLP-1 and PYY, which play essential roles in suppressing appetite and signaling satiety to the brain.

One of INFOGEST's most significant contributions is its ability to divide digestion into distinct stages—oral, gastric, and intestinal—allowing researchers to identify precisely when bioactive compounds are released. This structured approach provides a systematic understanding of nutrient transformation and supports evidence-based food formulation.

Advanced Laboratory Techniques: From Digestion to Real-Time Health Assessment

Modern laboratories are enhancing INFOGEST-based research by integrating it with advanced analytical tools:

- Metabolomics: Chemically trace nutrient and hormone dynamics, creating detailed kinetic maps of molecular interactions within the body.
- Enzyme Activity Assays: Evaluate how specific ingredients influence enzymes involved in glucose and lipid metabolism, offering insights into glycemic control and fat processing.

Cellular Response Studies: Digested components are applied to cultured intestinal or immune cells to assess inflammatory and regulatory responses, linking in vitro digestion models to physiological outcomes.

This multi-layered methodology provides a more comprehensive understanding of satiety and metabolic health compared to traditional nutritional studies.

Translating Scientific Insights into Consumer Benefits

Food manufacturers are increasingly leveraging digestion research to substantiate health-related claims with robust scientific evidence. For example, products designed to slow nutrient breakdown and prolong satiety are being developed for breakfast formulations intended to maintain fullness throughout the morning.

Similarly, snacks and meal replacements can be formulated to support energy balance and appetite management, particularly for individuals with high activity levels or irregular eating patterns.

In clinical nutrition, INFOGEST-supported findings guide ingredient selection and processing methods for managing conditions such as diabetes, obesity, and age-related metabolic changes. This ensures that dietary interventions are grounded in validated physiological mechanisms rather than anecdotal evidence.

The methodological rigor and reproducibility inherent in INFOGEST-based studies strengthen consumer confidence by linking product claims to measurable digestive and hormonal responses.

Challenges and Future Horizons in Satiety Research

Despite significant progress, digestive responses remain highly individualized, influenced by genetics, microbiome composition, age, and overall health status. While INFOGEST provides a standardized framework, future research must focus on:

- Integrating laboratory protocols with personalized human data to address variability in satiety responses.
- Employing advanced imaging and kinetic monitoring to correlate nutrient breakdown with objective hunger signals.
- Exploring novel ingredients such as fermented fibers, alternative plant proteins, unconventional milk sources, and bioactive extracts to expand satiety-enhancing options.

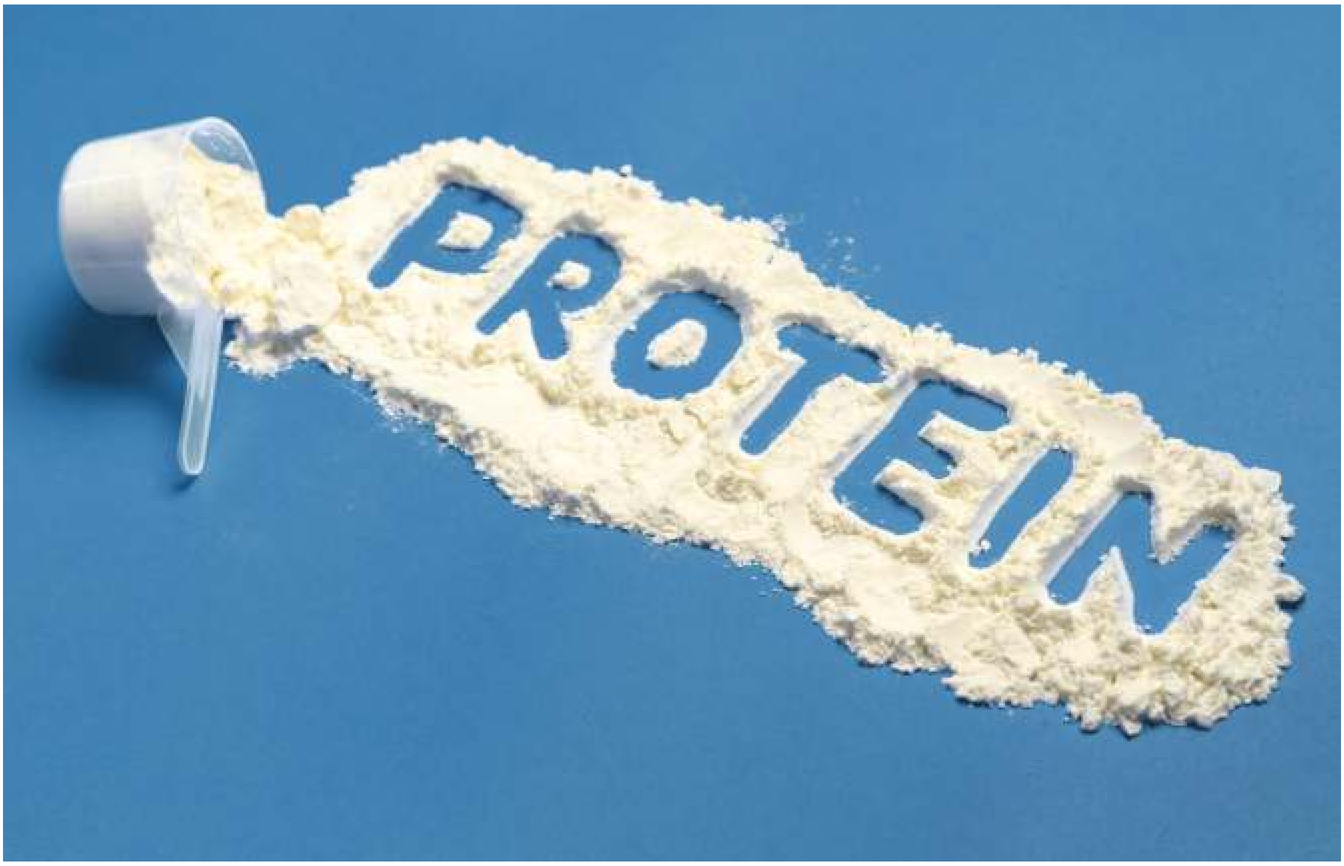
These advancements will support the development of targeted nutritional strategies tailored to diverse population needs.

Bridging Research and Real-Life Application

INFOGEST extends beyond being a laboratory protocol; it serves as a bridge between scientific discovery and practical dietary solutions. By enabling precise evaluation of how dietary fibers and proteins influence digestion and satiety, INFOGEST-based research contributes to the creation of healthier, more satisfying foods.

The integration of molecular insights, physiological responses, and consumer-focused innovation marks a decisive step toward truly evidence-based nutrition.

References are available upon request.



Protein Valorisation in Milk: Rationale & Framework

by **Sandeep Goyal**, The Value Alchemy

Context

In recent times, the dairy industry has been transitioning toward nutrition-led and functional foods. Protein enhances the nutritional value of milk and increases its economic worth. Among milk solids, protein is the most monetisable and value-accretive component. It is the key driver of margins in whey, cheese, dairy ingredients, derivatives, and nutrition-focused portfolios.

Despite its clear economic importance, current milk pricing systems in India do not explicitly recognise protein. Instead, it remains bundled within SNF (Solids-Not-Fat), effectively rendering it an invisible component from a pricing standpoint. As a result, protein is often underpriced relative to its true economic contribution.

Protein valorisation can transform milk pricing from a cost-based procurement model into a value-linked economic system. Paying separately for protein would ensure that farmers are rewarded not just for quantity, but for quality. This, in turn, encourages better feeding practices, improved animal health, genetic advancement, higher productivity, and modernised farm systems.

Composition of SNF in Milk

	Buffalo Milk: SNF (. 9.8%)		**Cow Milk: SNF (. 8.7%)**	
Component	% of SNF SNF	Ratio (approx.)	% of SNF	Ratio (approx.)
Protein	38.42%	~4.0	36.38%	~3.7
Lactose	52.54%	~5.3	54.56%	~5.5
Minerals & others	7.9%	~0.8	7.9%	~0.8
Ratio of components		40: 53: 7		37: 55: 8

Source: ICAR–NDRI (Karnal) dairy chemistry studies

The composition of SNF can be broadly simplified as follows:

- Cow Milk SNF: Protein 37% | Lactose 55% | Others 8%
- Buffalo Milk SNF: Protein 40% | Lactose 53% | Others 7%

Lactose is a disaccharide carbohydrate composed of glucose and galactose, and it constitutes the primary carbohydrate fraction in milk.

Key Takeaways

- Buffalo milk SNF is materially richer in protein compared to cow milk SNF.
- Lactose dominates SNF by weight in both cow and buffalo milk.
- However, lactose carries significantly lower economic value than protein.
- Current SNF-based pricing implicitly overvalues lactose and undervalues protein.
- Factors Determining Protein Content in Milk

Milk protein content is influenced by biological, nutritional, environmental and management factors:

1. Breed & Genetics

- Buffalo breeds such as Murrah, Nili-Ravi, Mehsana, Jaffarabadi, Surti, and Bhadawari show variation in protein levels.
- Indigenous cow breeds (e.g., Sahiwal, Gir) differ from exotic or crossbred cows (Holstein Friesian, Jersey) in protein yield and composition.
- Selective breeding can improve milk protein percentage over generations.

2. Stage of Lactation

- Early lactation: Higher protein percentage but lower overall volume.
- Late lactation: Protein percentage rises again as milk yield declines.
- Mid-lactation: Relatively lower protein percentage.

3. Nutrition & Feeding

- Balanced diets with adequate energy, bypass protein, and essential amino acids (lysine and methionine) enhance protein synthesis.
- Fodder vs concentrate ratio: Higher energy diets improve microbial protein synthesis in the rumen.
- Poor fodder quality or protein deficiency reduces milk protein content.

4. Animal Health

- Mastitis and metabolic disorders such as ketosis, acidosis reduce protein yield.
- Stress and poor immunity also lower protein conversion efficiency.

5. Environmental & Management Conditions

- Heat stress reduces dry matter intake, lowering protein output.
- Feeding systems (stall-fed vs grazing) impact nutrient intake and thus milk composition.
- Longer milking intervals may concentrate protein.

6. Seasonality

In India, milk protein content typically rises during winter (better fodder quality and cooler climate) and declines during summer due to heat stress and fodder scarcity.

Pricing Models for Milk in India

Milk pricing in India operates through cooperatives, private dairies, informal traders, and unorganised players. The key pricing models include:

1. Fat-Based Pricing (Single Axis Traditional Model)

- Price depends solely on fat percentage in milk.
- SNF may subject to minimum thresholds along with fat, charging a penalty for SNF lower than the threshold.
- Commonly used in buffalo milk procurement.
- Still dominant in many cooperatives and private dairies.

2. Fat + SNF Pricing

- Both fat and SNF are assigned weightage.
- Rates are derived from declared per-kg milk price and compositional percentages.
- Widely used for cow milk & mixed milk.

3. Flat-Rate Pricing

- Farmers are paid a fixed price per litre, irrespective of composition.
- Common in small-scale and informal markets.

4. Two-Part Pricing

- Base price (as per above models) plus quality-based bonuses.
- Bonuses linked to protein percentage, bacterial count, and absence of adulterants.
- May also include volume-based, frequency-based, seasonal, or modernisation incentives.
- Incentivizes farmers for hygiene and higher quality.

5. Premium/Branded Milk Pricing

- Differentiated offerings such as A2 milk, organic milk, and high-protein milk.
- Often priced 2–4 times higher than conventional milk.

E) Protein-Based Pricing: Economic Rationale

Although lactose dominates SNF by weight, its economic realisation is significantly lower than that of protein. Therefore, a value-based allocation approach is more aligned with economic reality.

1. Value-Based Allocation Model (Illustrative)

Assuming equal share of cow and buffalo milk:

- Average Lactose ≈ 54% of SNF
- Average Protein ≈ 38.5%
- Minerals & Others ≈ 7.5%

Market realisation from downstream products suggests:

- Protein (casein, cheese yield, whey protein concentrate) commands significantly higher value.
- Lactose has comparatively lower market value.
- Minerals have minimal commercial value.

Market realisations from downstream products clearly demonstrate the value differential. For instance, whey protein typically commands nearly three times the market price of lactose (though this ratio may vary depending on grade and market conditions). This significant price gap justifies allocating a higher share of SNF value to protein.

If value allocation is aligned with relative market recovery:

- Protein: 65% of SNF value
- Lactose: 31%
- Minerals: 4%

After adjusting mineral allocation on volume basis, effective value share becomes:

- Protein ≈ 66.8%
- Lactose ≈ 33.2%

This illustrates the structural undervaluation of protein under current SNF pricing systems.

Key Considerations for Implementing Protein-Based Pricing

- A gradual shift toward value-based or differential protein pricing is advisable.
- Stakeholder awareness about protein's economic significance is essential.
- Infrastructure, including NIR-based milk analysers, must support protein measurement at procurement points.
- Initial implementation may begin with protein-linked bonuses. Once the system gains maturity, then the pricing of milk could move on three axis bases.
- Adequate controls must prevent adulteration aimed at artificially increasing protein test values.
- FSSAI regulations already mandate minimum protein standards in products such as WPC, MPC, milk powders, infant formulae, infant cereals, and curd.

Protein deserves recognition both as a raw ingredient and as a finished-product value driver.

Conclusion

A transition to protein-based pricing cannot be implemented hastily. It requires stakeholder alignment, infrastructure readiness, trial validation of pricing formulas, and regulatory safeguards.

However, the current system does not explicitly recognise protein's economic contribution. By continuing to bundle protein within SNF, its true value remains obscured.

Over time, protein valorisation is likely to evolve into a virtuous cycle — enhancing long-term farm income, improving Return on Capital Invested (ROCI), strengthening incentives across the farm-to-factory value chain, and enhancing the global competitiveness of the Indian dairy sector.

About the author:

Sandeep Goyal is a seasoned finance and business leader with 33+ years Senior Operations Finance experience in Nestle. He has extensive experience on the milk value chain while working in Moga.

A distinguished alumnus, he graduated with distinction in Commerce from Punjabi University, Patiala (1987) and qualified as a Chartered Accountant (ICAI) in 1991. To strengthen his global perspective, he pursued advanced programs including Winning Sustainability Strategies at IMD Switzerland (2022) and a certification in Corporate Social Responsibility & BRSR Sustainability Reporting from ICAI.

Recently, Sandeep has laid the foundation of 'The Value Alchemy', a business and operations consulting firm focused on creating sustainable value for the businesses.

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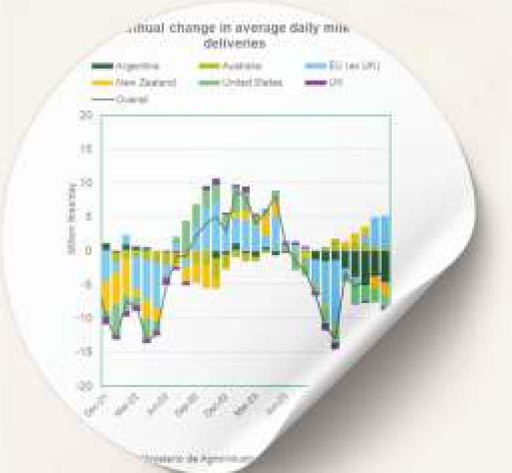

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India's Ghee Export Engine Consolidates

Destinations, State Corridors and District Powerhouses

(January–October 2025 Trade Analysis)

India's ghee export sector is entering a phase of structural consolidation. Between January and October 2025, exports reached USD 109.6 million, already surpassing the full-year 2024 levels. Imports remain negligible, reinforcing India's strong trade surplus in clarified butter.

Yet the headline figure only tells part of the story. The bigger change is geographic. Export activity is concentrating in specific state corridors and district-level industrial clusters, indicating a shift from scattered trade to more organised, processing-led growth.

The maps included in this issue clearly illustrate this development: India's ghee export landscape now has identifiable centres of activity.

A Stable and Expanding International Footprint

Ghee - Export Destinations 2025

Million USD

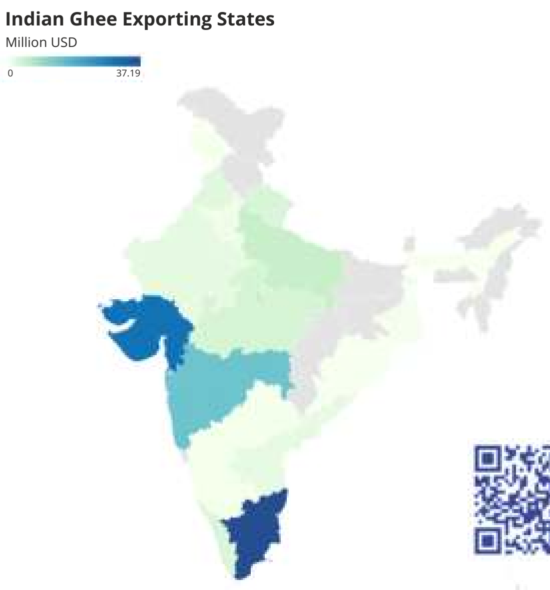
Source: Jordbrukare India - Created with Datawrapper

India's ghee exports remain centred in the Gulf Cooperation Council (GCC) markets. The United Arab Emirates alone accounts for over USD 32 million in shipments, making it the largest single destination. Qatar, Saudi Arabia, Oman, Kuwait, and Bahrain collectively support the Middle East as the main source of demand.

However, the United States has become the second-largest market, with exports nearing USD 19 million in the January–October period. This is significant. Unlike GCC markets, US demand increasingly focuses on retail shelf presence and the positioning of ghee within natural and clean-label cooking fat categories.

Australia and Singapore contribute further diversification, aiding India's shift from diaspora-driven exports to broader premium retail growth.

The global pattern indicates two concurrent strengths: stability in the Middle East and growth potential in developed retail markets.



Source: Jordbrukare India - Map data: © OSM - Created by Datawrapper

State-Level Consolidation: Southern and Western Dominance

Ghee exports are highly concentrated at the state level. Tamil Nadu leads with a 34% share, followed closely by Gujarat at 27%. Maharashtra contributes an additional 13%, forming a dominant southern-western export corridor.

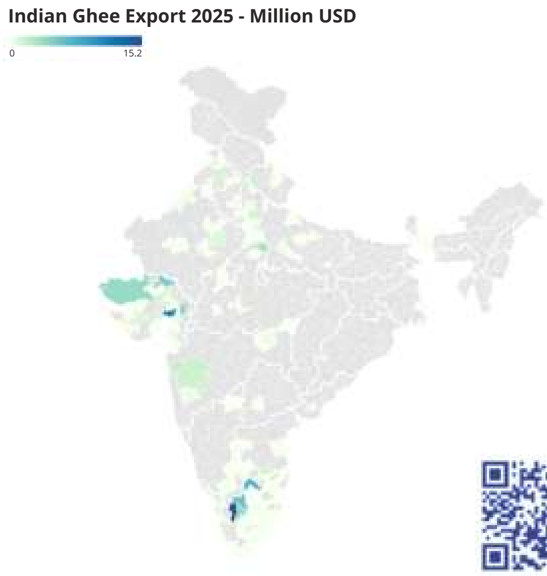
Together, Tamil Nadu and Gujarat account for more than 60% of India's ghee exports.

Tamil Nadu's strength lies in industrial-scale private processing, port proximity, and supply chain efficiency. Gujarat leverages its cooperative heritage, institutional networks, and established dairy ecosystem.

Maharashtra's exports are closely aligned with Western port infrastructure, especially through Mumbai.

Northern states are present but less dominant. Madhya Pradesh and Uttarakhand show emerging activity, indicating inland capacity expansion, though from a smaller base.

This state-level concentration reflects industrial maturity rather than regional imbalance. Ghee exports are primarily routed through organised processors equipped with compliance capabilities, sophisticated packaging, and export infrastructure.



Source: Jordbrukare Analysis - Map data: © OSM - Created by Datawrapper

District Powerhouses: The Industrial Nodes

At the district level, the picture becomes even clearer. Coimbatore in Tamil Nadu leads as the largest ghee-exporting district. Krishnagiri and Erode strengthen Tamil Nadu's cluster, while Chennai increases export capacity. In Gujarat, Anand and Banas Kantha continue to anchor cooperative-led exports. Kachchh and Ranch Mahals also contribute significantly, reinforcing the state's multi-node processing ecosystem. Mumbai and Thane remain key western gateways, aligned with port logistics and industrial processing. Emerging districts such as Bhind (Madhya Pradesh) and Dehradun (Uttarakhand) highlight new value-addition nodes beginning to participate in export flows. The geographic arc clearly shows a strong southern and western industrial corridor, supplemented by selective inland expansion.

Broader Participation Compared to Butter and SMP

When compared with butter and skim milk powder (SMP) exports, an important structural distinction becomes clear.

Butter exports are concentrated in a few high-volume districts and tend to react strongly to global fat price fluctuations. SMP exports, on the other hand, remain closely linked to spray-drying capacity and international powder cycles.

Ghee, by contrast, involves a wider range of states and districts. Its participation is more geographically dispersed and less reliant on short-term commodity cycles. This broader engagement indicates deeper integration within India's dairy value chain and reduces concentration risk.

The maps in this issue visually emphasise this contrast. While butter and SMP show strong activity in specific nodes, ghee demonstrates structured involvement across multiple corridors.

Why Ghee Stands Apart

Several factors explain ghee's relatively stable export trend:

- Persistent demand from the diaspora in the Middle East
- Growing retail acceptance in North America
- Strong domestic production infrastructure
- Organised processing capacity
- Limited reliance on imports

Unlike SMP, ghee is not primarily used to balance surpluses. Unlike butter, it is less affected by global volatility in fat prices. Instead, it holds a hybrid position: culturally significant yet commercially scalable.

The trade surplus highlights this structural advantage. With imports negligible, India retains a clear comparative advantage in clarified butter production and export.

The Strategic Outlook

With exports from January to October 2025 already surpassing last year's total, full-year figures are likely to set a new benchmark. However, the next phase of growth will depend less on increasing volume and more on capturing value. Key drivers will include:

- Retail brand penetration in the United States
- Improved market access in Europe
- Traceability and quality assurance systems
- Premium positioning and differentiated packaging

India's ghee export story is no longer incidental; it is becoming a defined industrial strategy. As the maps show, export strength is consolidating into identifiable power corridors. These corridors will shape India's dairy trade trajectory in the coming decade.

If the goal is stable, value-oriented dairy exports, ghee currently offers the strongest foundation within India's dairy portfolio.

Global Dairy Prices Rebound — But Structural Volatility Persists

Global dairy commodity markets began 2026 on firmer footing, with auction benchmarks strengthening across whole milk powder, butter and cheddar. After prolonged softness through late 2025, tighter milk flows in Oceania and improved demand from Southeast Asia contributed to a moderate price recovery.

However, this rebound should not be interpreted as a full structural recovery. Supply remains highly sensitive to weather patterns in New Zealand, feed cost fluctuations in the United States, and regulatory pressures in Europe. At the same time, Chinese import behaviour continues to influence global clearing prices.

For Indian dairy companies, particularly those exporting ghee and skimmed milk powder, higher global benchmarks improve realisations. Yet volatility remains embedded in the system. Short-term gains can quickly reverse with production recovery in major exporting nations.

The key lesson for India is strategic: commodity intelligence must become an institutional capability. Export-oriented processors can no longer operate in isolation from global cycles. Hedging strategies, forward contracts and real-time monitoring of auction indices are increasingly necessary.

The global dairy market has moved from predictable seasonal cycles to structurally volatile, geopolitically influenced pricing dynamics.

EU Milk Production Declines Under Sustainability Pressure

European Union milk output is projected to edge lower in 2026 as environmental compliance pressures reshape farm economics. Nitrogen emission caps in the Netherlands, methane-reduction mandates across member states, and water-use restrictions are accelerating herd reductions in several regions.

The EU's Green Deal policies are increasing operational costs, particularly for mid-sized farms. While productivity gains partially offset the decline, net milk expansion remains constrained. Consolidation is accelerating as smaller producers exit.

For India, this shift carries strategic significance. Reduced EU milk supply may tighten global SMP and butter availability, supporting international prices. At the same time, European processors are pivoting aggressively toward high-value cheeses and specialised dairy ingredients.

Indian exporters should view this through a dual lens. Short-term commodity opportunities may emerge, but access to European markets will increasingly depend on documented sustainability credentials. Carbon accounting, traceability and antibiotic monitoring are becoming de facto trade requirements.

The global dairy market is transitioning from volume-driven competition to compliance-driven competition. Indian processors targeting premium markets must prepare accordingly.

Fonterra Upgrades Milk Price Forecast, Signals Market Confidence

Fonterra Co-operative Group has raised its farmgate milk price forecast for the current season, citing stronger forward sales and resilient global demand. As the world's largest dairy exporter, Fonterra's payout announcements function as global market signals.

Higher payouts strengthen farm incomes in New Zealand but may also incentivise production in the next cycle. This dynamic reinforces the delicate balance between supply expansion and price stability.

For India, Fonterra's upward revision indirectly supports export pricing for milk powders and butterfat products. However, the cooperative's strategic emphasis on value-added ingredients rather than commodity expansion provides a deeper lesson.

New Zealand continues shifting toward specialised proteins, functional ingredients and premium dairy solutions. India, despite being the world's largest milk producer, remains heavily weighted toward commodity-oriented exports.

The global dairy narrative is increasingly centred on value density per litre rather than raw volume expansion. Indian processors seeking durable export growth must evaluate their positioning in higher-margin categories.

Arla Invests €300 Million to Expand Cheese Capacity

Arla Foods has committed €300 million to expand cheese production capacity in Sweden, reinforcing its strategic pivot toward value-added dairy categories.

European cheese consumption remains resilient, and export demand for speciality varieties continues to grow. Cheese delivers structurally higher margins compared to commodity powders. Branded portfolios also provide greater pricing power and consumer loyalty.

For Indian dairy leaders, Arla's investment underscores an important structural shift. Global dairy growth is increasingly concentrated in differentiated, consumer-facing products rather than bulk ingredient markets.

India's export basket remains dominated by ghee and SMP. Long-term competitiveness may require deeper investment in mozzarella, processed cheese for food service, and speciality cheeses tailored for Middle

Eastern and Asian markets.
Scale alone is no longer sufficient. Product innovation, branding and distribution sophistication define global leadership in dairy.

Whey Protein Demand Expands Structural Growth Corridor

Global demand for whey protein concentrates and isolates continues to expand, driven by sports nutrition, functional beverages and mainstream protein-enriched diets. Capacity expansion is underway in North America and Europe, yet supply remains tight relative to demand growth.
Whey has transitioned from a by-product status to a high-margin ingredient category. Food manufacturers increasingly use whey proteins for texture enhancement, nutritional fortification and clean-label formulation.
For India, this trend represents a significant untapped opportunity. Paneer and cheese production generates substantial whey volumes, much of which remains underutilised or sold at low value.
Investment in membrane filtration, drying facilities and ingredient marketing could unlock export potential and strengthen domestic protein markets. Urban India's health-conscious consumer segment is expanding rapidly, creating a growing market for high-protein dairy beverages.
India must reframe the waste stream as a strategic asset. The global protein economy is evolving faster than India's current processing ecosystem.

Sustainability Reporting Becomes Trade Gatekeeper

Environmental compliance is increasingly shaping global dairy trade. Retailers and multinational processors are embedding carbon-intensity metrics, methane-mitigation requirements, and water-use reporting into procurement contracts.
Scope 3 emissions disclosure is cascading from corporate sustainability frameworks to farm-level documentation. Suppliers unable to provide verifiable data risk exclusion from premium supply chains.
For Indian exporters, this development is critical. While domestic regulations remain comparatively flexible, export-oriented businesses must anticipate stricter reporting standards.
Sustainability has shifted from a reputational narrative to a market-access condition. Certification schemes and carbon benchmarking may soon function as non-tariff trade barriers.
Forward-looking Indian processors should invest in baseline carbon assessments and traceability infrastructure before compliance becomes mandatory.
The dairy trade of the next decade will reward

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transparency and environmental accountability as much as price competitiveness.

Global Dairy M&A Activity Set to Accelerate

Margin compression, compliance costs and capital intensity are driving renewed merger and acquisition activity in global dairy markets. Mid-sized processors face growing pressure to scale or specialise.

Consolidation enables cost optimisation in procurement, processing and sustainability investment. Larger groups also possess stronger balance sheets to navigate price volatility.

For Indian dairy, the implication is clear. Fragmented regional processors may struggle to meet future compliance and technology requirements without strategic partnerships or capital infusion.

Private equity and cross-border alliances are likely to shape the next decade of dairy restructuring globally. Scale and financial depth increasingly determine resilience.

Australia's Dairy Sector Stabilises

After years of contraction, Australian milk production is showing signs of stabilisation. Improved farmgate pricing and targeted policy interventions have slowed herd exits.

Australia remains a key exporter to Asian markets. Stabilised production could moderate regional price volatility.

For India, Australia serves as both a competitor and a knowledge partner. Advanced pasture systems and water-efficient dairy practices offer valuable lessons in climate resilience.

As climate variability intensifies across Indian dairy belts, adaptive strategies adopted in Australia may become more relevant.

China Remains the Global Swing Buyer

China continues to act as the largest swing factor in global dairy trade. Variations in Chinese SMP and WMP import demand can significantly influence global price trajectories.

Domestic production expansion has reduced import dependency in some segments, yet consumption growth remains uneven.

Indian exporters must monitor Chinese demand patterns, even if direct trade volumes are limited. Global price signals increasingly originate from shifts in Chinese procurement.

Commodity intelligence must include geopolitical monitoring.

Dairy Technology Investment Accelerates

Investment in dairy technology remains robust globally. Automated milking systems, methane-reduction feed additives, digital traceability platforms and AI-driven herd analytics are redefining productivity benchmarks.

Technology adoption improves cost efficiency, regulatory compliance and sustainability reporting.

For India, adoption remains uneven. Large commercial farms embrace advanced systems, but smallholder integration remains limited.

Bridging this technology gap will determine India's competitiveness in premium export markets.

Digitalisation, not merely milk volume, will define dairy leadership in the coming decade.

Global Dairy Foods Market Set for Nearly $2 Trillion Valuation by 2034, Asia Pacific Leading Growth

The global dairy foods market is projected to expand rapidly over the next decade, with total value expected to rise from approximately USD 1,063 billion in 2026 to nearly USD 1,995 billion by 2034, representing a CAGR of ~8.2 % through 2034. This forecast, based on analysis from industry market data and growth models, highlights the massive scale and ongoing structural transformation within the dairy sector globally.

Fortune Business Insights

Several key dynamics are driving this long-term trajectory. First, expanding middle-class populations in Asia, including China, India and ASEAN markets, are driving everyday dairy consumption across milk, yogurt, cheese, and value-added beverages. Asia Pacific already accounts for over 40 % of the global dairy foods market share, reflecting both population scale and rising consumer spending power on protein-rich diets and convenience dairy products.

Second, an accelerating trend toward engineered and fortified dairy ingredients including high-protein variants, lactose-reduced products and functional foods is lifting average product value in developed economies such as the United States and Europe, even as demographic headwinds temper overall dairy volumes in those regions.

From a competitive perspective, this long-range forecast underscores the strategic importance of investments in both production capacity and product innovation. Indian processors looking to capture export share must adapt supply chains, scaling both commodity staples and nutrient-enhanced dairy lines to meet diverse global demand.

Milma Seeks INR4/Litre Price Hike Amid Cost Pressures

Kerala Co-operative Milk Marketing Federation, popularly known as Milma, has formally requested a INR 4-per-litre increase in consumer milk prices, citing sustained increases in cattle feed, labour, logistics and veterinary costs. The proposal comes at a politically sensitive time ahead of state elections, placing the Kerala government in a difficult position between farmer welfare and consumer inflation management.

Milma argues that current procurement prices are insufficient to ensure farmer retention and milk supply stability. Cooperative leaders have emphasised that without an upward revision, producers may shift to private buyers offering marginally better rates. Kerala remains a milk-deficient state, importing significant volumes from neighbouring regions, making local production economics critical.

The development reflects a broader national trend: dairy cooperatives are under structural margin pressure as feed costs remain elevated while retail price increases face political resistance. For policymakers, the decision carries long-term implications. Delayed price correction risks weakening cooperative ecosystems, while immediate hikes may add to food inflation.

The episode underscores a larger question for Indian dairy: can farmer remuneration remain sustainable without periodic consumer price rationalisation?

Synthetic Milk Racket Exposes Persistent Adulteration Risks

Authorities in Gujarat dismantled a large-scale synthetic milk operation that allegedly blended limited quantities of genuine milk with chemically treated substitutes, including urea and caustic soda. The racket reportedly operated for several years, distributing adulterated milk across multiple districts.

The case highlights a persistent structural vulnerability in India's fragmented milk supply chain. While organised cooperatives maintain testing protocols, informal channels, particularly in peri-urban zones, remain susceptible to adulteration driven by margin arbitrage.

From an economic perspective, synthetic milk production arises when procurement price volatility and surging demand create incentives for dilution. Enforcement actions have increased in recent years, yet such cases reveal gaps in monitoring at aggregation points.

For processors and brands, the reputational risk is significant. Consumer trust remains the backbone of India's growth in dairy consumption. Incidents of adulteration not only undermine public health but also damage the credibility of the broader sector.

This episode strengthens the case for rapid, decentralised milk testing infrastructure and traceability frameworks. Technology-driven solutions, including portable spectroscopic and digital quality platforms, may become essential in closing this systemic loophole.

Cargill Expands Dairy Feed Capacity in Punjab

Cargill India announced a INR300 crore expansion of its dairy feed facility in Punjab, adding significant annual production capacity. The move aligns with growing demand for scientifically formulated cattle feed in northern India.

Feed accounts for nearly 60–70 percent of the milk production cost. As dairy intensification accelerates, nutritional efficiency becomes central to profitability.

Cargill's expansion signals confidence in organised dairy growth, particularly in high-yield regions such as Punjab and Haryana. Improved feed quality enhances milk yield, reproductive performance and disease resistance.

For the broader sector, the investment reflects a shift from volume-centric growth to productivity-centric growth. As land constraints tighten and herd sizes rationalise, yield improvement per animal will define competitiveness.

Feed innovation, therefore, becomes

FSSAI Intensifies Festive Anti-Adulteration Campaign

Ahead of Holi, the Food Safety and Standards Authority of India launched a nationwide inspection drive targeting milk and milk-derived products, including ghee, paneer and khoa. Festive seasons historically witness spikes in adulteration due to sudden demand surges.

Mobile testing units, interstate data integration and rapid response teams formed part of the strategy. The initiative reflects a preventive rather than reactive regulatory approach.

Seasonal enforcement is economically relevant because adulteration peaks distort short-term supply chains and erode brand equity. For organised processors, such drives are double-edged: while they increase compliance burdens, they also suppress informal competitors.

The broader strategic takeaway is clear. As India moves toward higher-value dairy consumption, particularly premium ghee and sweets, regulatory intensity will likely increase. Companies must invest in forward compliance rather than treat enforcement as episodic.

The Holi drive signals a regulatory evolution: dairy purity is becoming a political as well as commercial priority.