FACE
CII-Jubilant Bhartia
Food and Agriculture Centre of Excellence

Environmental Defense Fund

CII
Confederation of Indian Industry

Scaling Climate-Resilient and Productive Dairy Systems in India



RESILIENT DAIRY ALLIANCE
RDA

September 2026

Copyright © 2026 Confederation of Indian Industry (CII). All rights reserved.

No part of this publication may be reproduced, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise), in part or full in any manner whatsoever, or translated into any language, without the prior written permission of the copyright owner. CII has made every effort to ensure the accuracy of the information and material presented in this document. Nonetheless, all information, estimates and opinions contained in this publication are subject to change without notice, and do not constitute professional advice in any manner. Neither CII nor any of its office bearers or analysts or employees accept or assume any responsibility or liability in respect of the information provided herein. However, any discrepancy, error, etc. found in this publication may please be brought to the notice of CII for appropriate correction.

Published by Confederation of Indian Industry (CII), The Mantosh Sondhi Centre; 23, Institutional Area, Lodi Road, New Delhi 110003, India, Tel: +91-11-45771000 | Email: info@cii.in | Web: www.cii.in

Table of Contents

06 **Foreword**

08 **Executive Summary**

10 **Introduction**

1.1 Why this White Paper? 11
1.2 Objectives of the Paper 11
1.3 India's Dairy Sector: Opportunities and Challenges 12
1.4 Climate Change and the Dairy Sector 12

15 **Methodology and Evidence Base**

2.1 CII-FACE State Consultations 16
2.2 Resilient Dairy Alliance (RDA) 18
2.3 National Consultation 20
2.4 Analytical Approach 20

21 **Current Landscape of Climate-Resilient Dairy Systems in India**

3.1 Feed and Fodder Systems 22
3.2 Animal Health and Breeding 22
3.3 Climate-Smart Farm Management 23
3.4 Digital and Data Systems 24
3.5 Institutional Landscape 25

28 **Barriers to Adoption and Scaling**

4.1 Feed and Fodder Constraints 29
4.2 Farmer Adoption and Behavioural Barriers 30
4.3 Extension and Capacity Constraints 32
4.4 Animal Health and Genetics 33
4.5 Access to Finance 35
4.6 Market and Value Chain Constraints 36
4.7 Data and Digital Gaps 37
4.8 Policy and Institutional Challenges 39

41 Key Insights Emerging from the Consultations and RDA Discussions

5.1 Productivity is the Foundation of Climate Resilience in Indian Dairy 42
5.2 Feed and Fodder Systems are the Single Largest Opportunity for Transformation 42
5.3 Adoption Depends on Farmer Economics and Institutional Trust, Not Technology Alone 43
5.4 Multi-Stakeholder Partnerships are Essential for Scaling 44
5.5 Data Should Become a Strategic Asset for the Dairy Sector 45
5.6 Youth Engagement As a Long-term Sustainability Strategy 46

47 Policy Recommendations

6.1 Strengthen Feed and Fodder Systems 49
6.2 Improve Animal Health and Genetics 50
6.3 Strengthen Extension and Capacity Building 50
6.4 Expand Access to Finance 50
6.5 Improve Markets and Value Chains 51
6.6 Build Data and Digital Infrastructure 51
6.7 Strengthen Institutions and Governance 51

52 Roadmap for Scaling Climate-Resilient Dairy Systems

54 Conclusion

56 References



Acknowledgements

This White Paper was prepared under the Resilient Dairy Alliance initiative, a collaboration between the Environmental Defense Fund and the Confederation of Indian Industry's Food and Agriculture Centre of Excellence.

This paper is the product of sustained collaboration across government, industry, financial institutions, and civil society-and would not have been possible without the generosity of time, insight, and evidence that many individuals and organisations contributed across its development.

We are deeply grateful to the Department of Animal Husbandry and Dairying, Government of India, and to the state animal husbandry and dairy development departments of Uttar Pradesh, Tamil Nadu, and Maharashtra, whose engagement shaped the policy dimensions of this paper and whose field realities are at its heart.

We thank the members of the Resilient Dairy Alliance-across the feed and fodder, animal health and genetics, and enabling policy working groups-whose structured responses, practitioner evidence, and frank assessments of what is and is not working at scale constitute the backbone of this paper's findings. Their willingness to share operational data, organisational learning, and candid institutional perspectives gave this paper its analytical grounding.

The National Consultation on Pathways to Climate-Resilient and Productive Indian Dairy Ecosystem, held in New Delhi on 30 March 2026, provided the convening moment that validated and sharpened the paper's central arguments. We are grateful to all the panellists, participants, and institutional partners who contributed to that event.

Finally, and most importantly, we acknowledge the dairy farmers of India-whose daily decisions, whose resilience in the face of mounting climate and economic pressure, and whose quiet expertise are the reason this work exists and the measure by which its recommendations will ultimately be judged.

We also extend our sincere appreciation to the National Dairy Development Board (NDDB), particularly Dr Meenesh Shah, Chairman; Dr Rajesh Sharma, Deputy General Manager; and Dr Bhupendra Phondba, Senior Manager, for their valuable contributions and institutional perspectives, which have enriched the paper.

Report writing and editing

CII FACE

- Mr Saurabh Dwivedi

EDF

- Mr Vrashabh Kapate

SDS-EDF

- Mr Vinay Menon

With contribution from

CII-FACE

- Ms Kavita Choudhry
- Mr Rashid Ul Khair Nazki
- Dr Kritika Gadpayle
- Ms AV Rajamany
- Ms Roli Pande
- Ms Jyoti Gupta
- Dr Pragya Joshi

EDF

- Mr John Tauzel
- Dr Abhinav Gaurav
- Ms Katie Anderson
- Dr Vijayalakshmi Kennady
- Dr Joe Rudek
- Ms Kuntal Shah

Foreword



Milk production has increased from 146.31 million tonnes in 2014–15 to 247.87 million tonnes in 2024–25, representing a compound annual growth rate of approximately 5.4% over the decade. This growth is a significant achievement and reflects the strength of India's dairy ecosystem and the contribution of millions of farmers who sustain it.

Dr Meenesh Shah

Chairman
National Dairy Development Board

India's dairy sector is central to the country's rural economy and has a deep connection with the livelihood, nutrition, and social fabric of millions of households. Today, India is the world's largest milk producer, and the sector has continued to expand steadily. Milk production has increased from 146.31 million tonnes in 2014–15 to 247.87 million tonnes in 2024–25, representing a compound annual growth rate of approximately 5.4% over the decade. This growth is a significant achievement and reflects the strength of India's dairy ecosystem and the contribution of millions of farmers who sustain it. The next phase of dairying, however, will require us to look beyond growth in production alone. Rising temperatures and heat stress, changing rainfall patterns, water constraints, feed and fodder challenges, animal health concerns, and other climate-related pressures are increasingly influencing dairy productivity and farmer income. Building resilience to these changes must therefore be an integral part of India's dairy development pathway.

The diversity of India's dairy sector also calls for solutions that are practical, economically viable, and suited to local conditions. For smallholder farmers in particular, climate resilience must go hand in hand with productivity and profitability. The objective should be to enable farmers to produce more efficiently, strengthen their income, and remain resilient in the face of changing climatic conditions. This will require collective effort across Government institutions, cooperatives, private dairy companies, farmers, financial organisations, research institutions, and development partners. As the apex organisation for the dairy development in India, the National Dairy Development Board (NDDB) has a pivotal role in catalysing this transformation by enabling dairy cooperatives to integrate productivity, profitability, climate resilience and environmental sustainability into their development pathways. NDDB is working to promote and scale practical, science-based and farmer-centric, and accessible solutions that enhance resource efficiency, reduce environmental footprints, strengthen climate resilience, and improve economic returns for millions of smallholder dairy farmers, while enhancing the competitiveness and long-term sustainability of the dairy sector. Sharing evidence and experience, strengthening institutional linkages, and creating an enabling environment for investment and adoption will be critical to taking proven solutions beyond individual pilots towards wider scale.

The partnership between the CII Food and Agriculture Centre of Excellence (CII-FACE) and the Environmental Defense Fund (EDF) contributes to this effort by bringing together stakeholders from across the dairy value chain to examine the challenges and opportunities associated with climate-resilient dairy development. This partnership is anchored by the Resilient Dairy Alliance (RDA), a multi-stakeholder platform that brings together government departments, cooperatives, private sector players, and NGOs to advance climate-resilient dairy practices on the ground. The work has highlighted an important opportunity for the sector: many of the solutions required are already being demonstrated in different parts of the country; the greater challenge is to create the conditions that enable these solutions to be adopted and scaled.

The White Paper, Scaling Climate-Resilient and Productive Dairy Systems in India: Barriers to Adoption, Pathways for Scale, and Opportunities for Strengthening the Ecosystem, makes a timely contribution to this dialogue. By bringing together stakeholder perspectives and evidence from across different dairy systems, it draws attention to the barriers that need to be addressed and the pathways that can support wider adoption of climate-resilient and productivity-enhancing practices. Its central message is particularly relevant for India: productivity and climate resilience need not be pursued as separate goals; when approached thoughtfully, they can reinforce each other.

The way forward will depend on our ability to take successful ideas beyond demonstration and into sustained practice. This will require stronger connections between research and field implementation, effective extension and advisory systems, access to appropriate finance, supportive policies, and continued sharing of experience across states and institutions.

I commend CII-FACE, EDF, and all the stakeholders who have contributed to this effort for bringing together diverse perspectives on an issue that will become increasingly important for the future of Indian dairying. The opportunity before us is to build on India's remarkable dairy growth and ensure that the next phase is defined not only by higher production, but by prosperous farmers, more resilient dairy systems, and more sustainable growth. Scaling solutions through collective action, while keeping farmer prosperity at the centre, will be key to achieving this vision.

Executive Summary

India's dairy sector is the backbone of rural livelihoods, nutrition security, and women's empowerment across the country, and India's global leadership in milk production is a genuine national achievement. That achievement is now under strain. Rising temperatures, erratic rainfall, water scarcity, and shifting disease pressure are already measurably reducing milk yields, raising production costs, and disrupting the reliability of milk procurement, for smallholder farmers and organised dairy businesses alike.

Climate stress on India's dairy sector is now measurable, not merely anticipated. Literature on dairy production and heat stress consistently shows that rising temperatures and humidity adversely affect animal productivity, with Indian studies documenting significant reductions in milk yield as temperature-humidity index (THI) rises. Industry stakeholders corroborate this evidence on the ground, reporting a 5–6% decline in milk yield for every 1°C rise in temperature, and losses of 1.5–2 litres per animal per day during recent summer seasons compounded by shifting vector-borne disease dynamics and seasonal fodder shortages. These pressures are already visible in corporate financial results and directly impair smallholder viability.

This paper argues that scaling climate-resilient and productivity-enhancing dairy practices are no longer a discretionary sustainability agenda; it is fast becoming a precondition for the continued growth of India's dairy economy. The technical solutions required, better breeds, balanced feed, forage/fodder security, improved animal health, climate-smart housing, digital advisory, and circular waste management, are largely known and, in many cases, already being piloted successfully by government agencies, cooperatives, Milk Producer Companies (MPCs), and private dairy companies.

These solutions aim for a triple win- higher productivity and income for farmers, improved business outcomes for dairy companies and a sustainable, climate-resilient dairy ecosystem.

The critical gap is not only in innovation, but in the institutional coordination, financing architecture, and delivery systems needed to move these solutions from isolated pilots to sector-wide practice.

This paper synthesises evidence from four connected bodies of work undertaken between 2025 and 2026:

- CII-FACE State Consultations conducted with government departments, cooperatives, MPCs, private dairy companies, feed manufacturers, and academic institutions across Uttar Pradesh, Tamil Nadu, and Maharashtra;
- Resilient Dairy Alliance (RDA) discussions which brought together government, industry and researchers to validate and refine emerging findings;
- The National Consultation on Pathways to Climate-Resilient and Productive Indian Dairy Ecosystem (30 March 2026, New Delhi), convened by CII-FACE and EDF.
- Secondary literature, government scheme documentation, and industry evidence.

However, translating this growing evidence of climate stress into sustained, sector-wide action remains constrained by a set of interconnected barriers. These include gaps in farmer awareness and access to climate-resilient practices, limited financing for adaptation, fragmented institutional coordination, and uneven availability of appropriate technologies and delivery systems. The table below summarises the key barriers that currently limit the scale and effectiveness of climate resilience efforts across India's dairy sector.

Table No.1 - Key Barriers to Climate-Resilient Dairy Development

Barrier Category	In Brief
Feed & fodder	National feed and fodder deficits, seasonal availability gaps, low silage adoption, and unregulated feed and feed ingredients suppress productivity across all three states.
Farmer adoption	Awareness is rarely the constraint; the absence of consistent follow-up and affordable, low-risk pathways to adopt new practices is.
Extension & capacity	Strengthening last-mile delivery requires integrating para-veterinarians, AI technicians, and extension/field workers alongside formal veterinary channels.
Animal health & genetics	Disease burden, limited Artificial Insemination coverage outside formal networks, and weak surveillance constrain productivity and resilience gains.
Access to finance	Bank-loan components of otherwise well-designed schemes stall at the last mile; MPCs remain excluded from cooperative-equivalent subsidies.
Markets & value chains	No price incentive that rewards climate-resilient practice; unregulated feed and feed ingredients, and informal-market competition erode formal-sector leverage.
Data & digital systems	Animal records, productivity data, and emissions measurement remain thin, limiting targeting, financing, and traceability.
Policy & institutions	Fragmented departmental mandates and weak convergence mean farmers navigate multiple windows for support.

Six insights recur across every geography and forum consulted: productivity improvement is the most practical entry point to resilience; feed and fodder systems are the single largest lever for cost, productivity, and emissions gains; adoption follows farmer economics, not technology, alone; trusted local extension remains indispensable even as digital tools scale; multi-stakeholder platforms such as the RDA are essential to move from pilots to systems; and data must become a strategic, shared asset for the sector.

Taken together, the evidence points to one overarching conclusion: India already possesses most of the technical building blocks of a climate-resilient dairy sector. The task ahead is systemic, not technological, focused on the strengthening multi-stakeholder coordination, innovative financing mechanisms, and robust farmer-facing delivery systems that can scale these interventions effectively built over the next few years.



01.
Introduction



1.1 | Why this White Paper?

The Resilient Dairy Alliance (RDA) was jointly constituted in December 2025 by the Confederation of Indian Industry – Food and Agriculture Centre of Excellence (CII-FACE) and the Environmental Defense Fund (EDF) as a collaborative platform to identify and address common barriers to the adoption and scaling of climate-resilient practices across India's dairy value chain. Simultaneously, CII-FACE initiated structured consultations across Uttar Pradesh, Tamil Nadu, and Maharashtra to move beyond generalised statements about climate risk and build a grounded, stakeholder-validated picture of what is limiting the adoption of climate-resilient and productivity-enhancing dairy practices on the ground.

A consistent theme across every forum, state consultations, RDA Technical Working Groups, and the National Consultation, is that many of the technical solutions required already exist. Artificial insemination, vaccination protocols, balanced ration balancing/precision feeding, microclimate/heat-mitigation housing practices, silage technology, biogas systems, digital advisory tools, and climate-resilient breeds are all in active use somewhere in India's dairy ecosystem. What remains limited is adoption at scale. This paper attempts to explain why, and to set out a practical, phased pathway for closing that gap.

1.2 | Objectives of the Paper

This white paper aims to:

- Identify the principal barriers limiting the adoption and scaling of climate-resilient and productivity-enhancing dairy practices in India;
- Synthesise stakeholder perspectives gathered through the CII-FACE state consultations in Uttar Pradesh, Tamil Nadu, and Maharashtra;
- Capture the strategic insights that emerged from Resilient Dairy Alliance discussions and the National Consultation;
- Recommend policy, institutional, and financing actions to scale climate-resilient dairy systems, sequenced into a practical short-, medium-, and long-term roadmap.



1.3 | India's Dairy Sector: Opportunities and Challenges

India is the world's largest milk producer, contributing nearly a quarter of global milk output, with national production estimated at 247.87 million tonnes in 2024-25 and per-capita milk availability of 485 grams per day, among the highest in the world (Basic Animal Husbandry Statistics, 2025). Per-capita consumption has risen from roughly 110 grams to 460 grams per day over the past five decades and is projected to approach 850 grams per day within the next 25 years as incomes rise and diets diversify (Indian Dairy Association).

This growth rests on a distinctive structural foundation: more than 80 million households, the overwhelming majority of them smallholders managing two to five animals, sustain the sector. Women perform an estimated 80% of on-farm dairy labour and make most day-to-day management decisions, making dairy one of India's most important sources of women's rural livelihoods, even though benefits of credit, extension, and policy frameworks frequently not reaching women.

To bridge this gap, technical interventions, especially around heat-stress management, balanced feeding and clean/hygienic milk production must be organised.

As the National Consultation on Pathways to a Climate-Resilient and Productive Indian Dairy Ecosystem (30 March 2026) underscored, India's dairy sector now stands at an inflection point: policy is increasingly oriented toward export readiness, quality standards, and deeper private-sector participation, even as the sector's foundational productivity challenge remains unresolved. India's milk yield per animal continues to lag well behind global benchmarks, and closing this gap, rather than expanding herd size on land and resources that are already under pressure, is now widely recognised as the central lever for improving farmer incomes, strengthening food security, reducing enteric emissions intensity per litre of milk and building climate resilience simultaneously.

1.4 | Climate Change and the Dairy Sector

Climate change is affecting Indian dairy production through three interlocking channels that stakeholders consistently distinguish in practice: an overall supply challenge driven by heat stress resulting in fodder and water scarcity; a quality challenge, visible in declining fat and Solids-Not-Fat (SNF) content that undermines value-added product (VAP) margins; and an animal-specific challenge, since India's dairy herd is not uniformly vulnerable to a warming climate. Extended inter-calving intervals and silent heats resulting from heat stress also prolong the non-productive days across herds, directly increasing the feed maintenance overheads for farmers, at the same time, elevating the emission intensity.



The overall supply challenge

Heat stress is the most immediately visible climate impact on dairy productivity. As ambient temperatures rise, animals divert energy toward thermoregulation rather than milk production, resulting in lower yields, shorter lactation periods, impaired reproductive performance, and greater susceptibility to disease. Prolonged heat stress can reduce female fertility by 20-30%, while milk production and reproductive performance may decline by as much as 58.3% and 63.3% respectively under severe conditions (ICAR-NDRI, 2023).

A national survey by the Council on Energy, Environment and Water (CEEW), found that 12-14% of dairy farmers are already experiencing reduced milk production due to rising temperatures, with more than half of buffalo and crossbred-cattle owners reporting climate-related impacts on production. (1,3)

This is compounded by a structural feed and fodder deficit. National estimates place the shortfall at roughly 40-50% of requirement, while ICAR's 'Comprehensive Assessment of Feed and Fodder Resources for Increased Livestock Production in India (2026)' estimates a deficit of 14.1% for green fodder and 2.4% for dry fodder. Rising temperatures and erratic rainfall reduce both the availability and the nutritional quality of fodder, while water scarcity simultaneously constrains fodder cultivation and farmers' ability to cool their animals, compounding heat stress. (4)



The quality challenge: fat, SNF, and value-added margins

A less visible but commercially significant dimension is the effect of climate and nutritional stress on milk composition. Stakeholders in Maharashtra, for instance, identified persistent challenges with ration balance and low Solids-Not-Fat (SNF) levels, which directly affect the milk quality on which value-added products (VAP) such as paneer, cheese, and curd depend. Because VAP portfolios increasingly anchor dairy company margins, a quality-driven supply constraint has commercial consequences that extend well beyond raw milk volumes.
The potential scale of these commercial implications is also reflected in forward-looking economic modelling. Choudhary and Sirohi (2022) estimated that heat stress alone could result in annual milk production losses of approximately 361,000-377,000 tonnes in the North Indian Plains under an RCP 4.5 climate scenario, translating into annual economic losses of approximately ₹11.93-12.44 billion.

While this estimate captures direct farm-level production losses rather than downstream industry impacts, it highlights the potential magnitude of climate-related supply disruption for the wider dairy value chain. Such disruptions could, in turn, affect procurement costs, sourcing reliability, milk quality, and utilisation of processing capacity areas where systematic quantification remains an important evidence gap.



The animal-specific challenge

India's dairy herd is not uniformly exposed to climate risk. Buffalo contributes a substantial share, to the order of 45%, of India's total milk production, and, alongside crossbred cattle, are considerably more vulnerable to heat stress than indigenous breeds. Research confirms that crossbred cattle are the most susceptible to heat stress, followed by buffaloes, with indigenous cattle showing greater resilience (ICAR-NDRI, 2023). Consultations across all three states corroborate this: indigenous breeds such as Sahiwal, Gir, and Tharparkar consistently demonstrated more stable performance under heat stress than crossbred or exotic high-yielding animals, reinforcing the case for climate-resilient breed strategy as a first-order productivity and resilience lever, not simply a genetic-conservation objective.



Signals of present-day business stress

Future productivity decline is a serious concern, but the evidence also indicates that climate-related supply stress is already visible in current financial performance, not only in future risk projections. Heritage Foods, one of India's larger listed dairy processors, reported a 36.7% year-on-year decline in consolidated net profit to approximately ₹24 crore in Q4 FY26, with EBITDA down 34.6% and EBITDA margin contracting from 7.6% to 4.5%, despite 10.4% revenue growth.

The company attributed this directly to "severe milk shortages and elevated procurement inflation" during the financial year, alongside a weak flush season (Business Standard, May 2026). This pattern, revenue growth outpaced by procurement-cost inflation, is consistent with what stakeholders described qualitatively across all three consultation states. (9). This margin squeeze highlights how climate-induced seasonal supply deficits directly trigger procurement cost spikes, indicating that climate resilience in animals is a direct driver of corporate supply-chain stability and financial performance.

Box 1: How Severe is Climate Stress Today? Evidence Beyond Future Projections

A CEEW study covering more than 7,300 cattle-rearing households found that 12-14% of dairy farmers are already experiencing reduced milk production due to rising temperatures, and more than half of buffalo and crossbred-cattle owners reported climate-related production impacts. Heritage Foods reported an estimated 5-6% decline in milk yield for every 1°C rise in temperature, and a 1.5-2 litre/day decline in farmer productivity linked to rainfall variability and water scarcity.

Companies are already beginning to respond to climate and supply-chain risks operationally rather than treating them solely as future concerns. Consultations indicate that Katraj Dairy is exploring insurance-linked mechanisms to compensate farmers above 40°C; CavinKare has begun early-stage discussions on formal carbon-footprint measurement; and processors including Sonai, Parag, and Schreiber are exploring whey-protein valorisation as a means of strengthening value recovery amid volatile raw-milk procurement. The emerging role of insurance is particularly noteworthy: under the Government of India's National Livestock Mission, the farmer's share of livestock-insurance premiums has been reduced to 15%, with the remaining 85% supported by the Centre and States, and the eligibility ceiling has been increased to 10 cattle units per household. By July 2025, the programme had released ₹135.3 crore and insured 55.86 lakh animals over the preceding five years; a further 21.01 lakh animals were insured during FY2024–25 at the time of the March 2025 reporting. The Government has also already supported a more targeted climate-risk product: a heat-index-based cattle insurance product launched in Kerala provided coverage of up to ₹2,000 per animal, with premiums of 4–5%, and was designed to compensate farmers for milk-production losses associated with high temperatures, with approximately 15,000 cattle targeted for coverage. These developments suggest that insurance can become a useful market-based indicator of how climate risk is increasingly being recognised and priced.

https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2114716&lang=2&reg=48&utm
https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2042171&lang=2&reg=48&utm

02.
Methodology and Evidence Base

This chapter explains where the paper's findings come from and how they were synthesised, so that readers can weigh the evidence on its merits.



2.1 | CII-FACE State Consultations

CII-FACE conducted structured consultations in Uttar Pradesh, Tamil Nadu, and Maharashtra. These three states were selected deliberately for their contribution to the national milk production and the diversity they offer, in agro-climatic conditions, production systems, and institutional maturity. Together, they account for approximately 27.5% of India's total milk output across three distinct regional contexts.

Uttar Pradesh is India's single largest milk-producing state, accounting for 16.21% of national milk production in 2023-24 (Basic Animal Husbandry Statistics, 2024), and is characterised by a large, fragmented smallholder base and relatively nascent cooperative infrastructure, with Milk Producer Companies (MPCs) handling roughly 20% of organised procurement. It represents the scale challenge: how climate-resilient practice reaches a very large, dispersed, and still-consolidating producer base.

Tamil Nadu, though outside the national top five by volume (4.57%), has one of India's most mature and organised dairy ecosystems, anchored by the Aavin cooperative federation and substantial private-sector investment in processing and value-added products. It represents the maturity case: how a relatively well-institutionalised system can push further on quality, traceability, and premiumisation.

Maharashtra, the fifth-largest milk-producing state nationally (6.71% of national production), presents a mixed landscape, commercially advanced cooperative and private dairy hubs in western districts such as Pune and Nashik alongside subsistence-level livestock rearing in the drought-prone Marathwada and Vidarbha regions. It represents the transition case: a state where climate exposure, market development, and institutional capacity vary sharply within the same state boundary.

Together, the three states span roughly a quarter of India's national milk production and a wide cross-section of production systems, cooperative maturity, and climate exposure, providing a reasonably representative, though not exhaustive, evidence base for recommendations.

Consultations were held as structured one-on-one meetings and dialogue sessions with senior leadership, field teams, and technical staff across State Animal Husbandry Departments, Dairy Development Departments, cooperatives, MPCs, private dairy companies, cattle feed manufacturers, and academic and technical institutions. Sessions were designed to draw out four categories of information: current operational practices related to climate resilience; barriers experienced at the farm, institutional, market, and financial levels; examples of initiatives that are working and could be scaled; and stakeholder perspectives on policy gaps and the enabling environment.



Our Focus Across Key States



16.21%
Share of national production

Agroclimatic conditions

- Subtropical, semi-arid to sub-humid
- Hot summers, cool winters
- Alluvial plains with high fodder potential

Institutions & companies covered

- Gyandhara
- Gyan Dairy
- Saamarthya MPC
- DAHD Department



6.71%
Share of national production

Agroclimatic conditions

- Semi-arid to sub-humid; coastal to plateau regions
- Moderate to high rainfall (coastal belt)
- Diverse topography and fodder availability

Institutions & companies covered

- Sonai Dairy
- Katraj Dairy
- Sistema Bio
- Mittal Farms
- DAHD Maharashtra



4.57%
Share of national production

Agroclimatic conditions

- Tropical, coastal, semi-arid to sub-humid
- Moderate rainfall; distinct wet and dry seasons
- Strong emphasis on fodder cultivation and dairying systems

Institutions & companies covered

- Heritage Foods
- Kumarguru Institutions
- CavinKare

Structured Consultations with Key Stakeholders

- Government Departments
- Cooperatives & MPCs
- Private Dairy Companies
- Cattle Feed Manufacturers
- Academic & Technical Institutions

2.2 | Resilient Dairy Alliance (RDA)

Resilient Dairy Alliance: A Multi-Stakeholder Platform for Sector Transformation

The Resilient Dairy Alliance (RDA) was jointly constituted by the Confederation of Indian Industry – Food and Agriculture Centre of Excellence (CII-FACE) and the Environmental Defense Fund (EDF) as a collaborative platform to identify and address common barriers to the adoption and scaling of climate-resilient practices across India's dairy value chain. The Alliance brings together 19 companies and organisations representing the diversity of India's dairy ecosystem, including cooperatives, private dairy companies, Milk Producer Companies, women-led producer institutions, feed and input providers, animal-health companies, and technology and solution providers.

This diversity enables the Alliance to bring together perspectives from different parts of the value chain and identify solutions that can be adapted and scaled across different dairy production and procurement models.
The RDA provides a structured forum for members to collectively examine barriers, share experience from different geographies, validate emerging solutions, and identify opportunities for collaborative action.

Working sessions with Alliance members are convened regularly to move beyond information sharing towards practical problem-solving, with discussions focused on priority areas such as feed and nutrition, animal health and breeding, manure management, climate-resilient farm practices, technology adoption, and mechanisms for scaling proven solutions. These sessions also provide an opportunity to test findings emerging from state-level consultations against the experience of companies and organisations operating across different regions, helping distinguish challenges that are location-specific from those that recur across the national dairy ecosystem.

The RDA website, launched alongside the National Consultation, is intended to serve as a digital backbone for this broader ecosystem—not only for Alliance members but for stakeholders across the dairy sector. It provides a shared platform for accessing insights, tools, and resources on climate-resilient dairy practices, tracking progress on RDA initiatives and on-ground pilots, and facilitating knowledge exchange across geographies. The longer-term objective is to use the Alliance as a mechanism for translating evidence and industry experience into scalable solutions, stronger collaboration, and coordinated action across India's dairy sector.



RDA Members across India

Mapped by main office of operation (HQ State)



Government / Public Institution

Cooperatives / MPCs

Dairy Companies / Processors

Feed & Input Providers

Animal Health Companies

Technology & Solution Providers

Conglomerates / Others

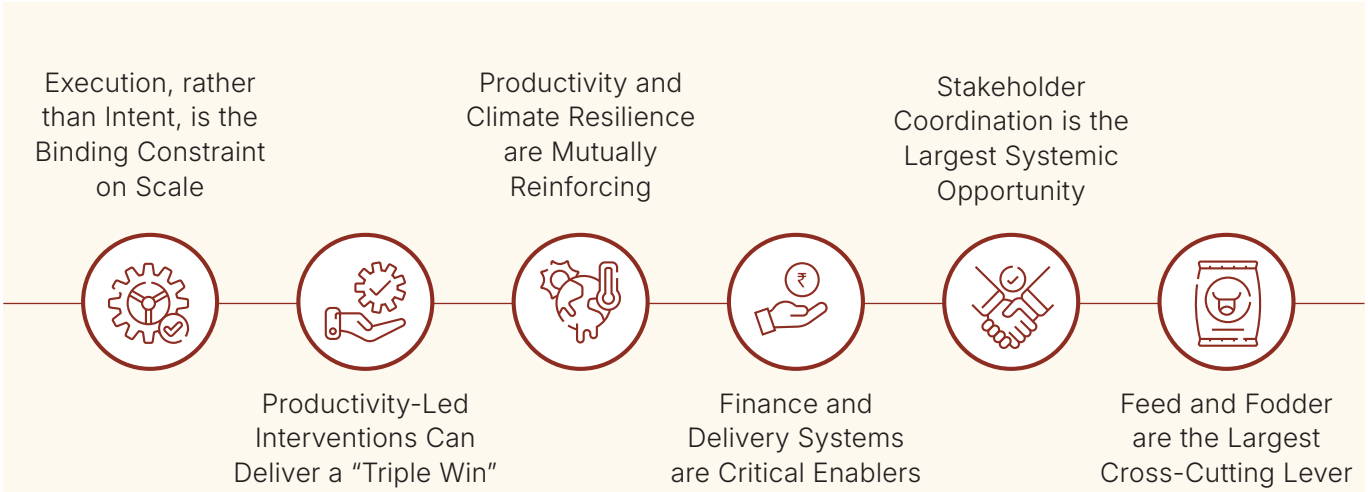
Note: Map not to scale. Locations indicate headquarters / main corporate office state. Some companies operate across multiple states.

2.3 | National Consultation

The National Consultation on Pathways to Climate-Resilient and Productive Indian Dairy Ecosystem was held in New Delhi on 30 March 2026, convened jointly by CII-FACE and the Environmental Defense Fund. The consultation's objective was to bring senior government representatives, industry leaders, and financial institutions together to chart a collective vision for a climate-resilient dairy sector.

Major stakeholder participation spanned the Department of Animal Husbandry and Dairying (represented by Additional Secretary Varsha Joshi), NABARD (represented by Chairman Shaji K V), and industry leaders including C.P. Milk & Food Products, Heritage Foods, Danone India, Godrej Industries, Cargill Animal Nutrition & Health, Sistema.bio, Akshayakalpa Farms, Dvara E-Dairy Solutions, the International Finance Corporation (World Bank Group), National Dairy Development Board, Intellecap, TechnoServe, and Kumaraguru Institutions, among others, across three thematic sessions cover ing (i) policy, finance, and institutions; (ii) scaling innovation from pilot to impact; and a closing session on collective priorities.

Key Outcomes included Six Consolidated Takeaways



2.4 | Analytical Approach

Evidence from the three state consultations, RDA Technical Working Group discussions, the National Consultation, and secondary literature (peer-reviewed research, and recent industry and corporate reporting) was synthesised thematically. Recurring issues raised independently across multiple states, organisation types, or forums were treated as higher-confidence findings; issues raised by a single organisation or in a single geography are flagged as such and treated as illustrative rather than representative. Where quantitative claims originate from a single stakeholder's operational data rather than an independently verified source, this is noted in the text. This approach prioritises triangulation over volume: a finding repeated by a state government department, a private processor, and an RDA Technical Working Group carries more analytical weight in this paper than one raised only once, even where the latter is vivid or compelling.

03.

Current Landscape of Climate-Resilient Dairy Systems in India

Before turning to barriers, it is important to establish where India's dairy sector currently stands. The consultations reveal a wide spectrum of practice adoption, ranging from interventions that are already standard across the organised sector to those still at a pilot stage.



3.1 | Feed and Fodder Systems

Concentrate feed supply is a standard component of most private-sector procurement models across all three states. CavinKare Dairy supplies concentrate feed directly to farmers, who typically maintain a 60:40 ratio of own roughage or green fodder to company-supplied feed, a ratio broadly aligned with the recommended balance between forage and concentrate for productive dairy animals. Saamarthya Milk Producer Company, in partnership with Godrej Agrovet and Japfa India, is developing and delivering a Type-1 cattle feed containing more than 22% protein directly to villages, while Heritage Dairy produces high-protein feed supplements in the 22-25% protein range for its supply base.

Silage is emerging as one of the most actively promoted solutions to seasonal fodder shortages. The Government of Uttar Pradesh has made silage production mandatory, directing a supply of 3 kg per animal per day, while Kumaraguru Institute and Saamarthya MPC are piloting silage adoption. However, actual uptake remains limited, particularly among smallholders who often lack the capital, technical knowledge, and infrastructure needed for cost-effective silage production. In Tamil Nadu, many farmers continue to rely on low-cost feed ingredients such as bran, broken rice, and chunni (outer grain husk) due to inconsistent access to quality green fodder. Similarly, crop-residue utilisation and feed optimisation remain uneven across production systems.

These challenges are rooted in a broader structural deficit in India's feed and fodder systems. According to ICAR (2026), the country faces a green fodder deficit of 14.1% and a dry fodder deficit of around 2.4%. These shortages are further exacerbated by widespread unregulated feed and feed ingredients and the absence of mandatory compliance of quality standards, affecting both productivity and livestock nutrition.

Feed and fodder systems were identified at the March 2026 National Consultation as the sector's largest lever for improving farmer incomes, reducing milk production costs, and lowering emissions. Feed accounts for 60–70% of milk production costs, while silage-based feeding can improve milk yields by 10–15%; however, existing policy and financing instruments remain fragmented and insufficiently linked to local fodder needs. Establishing "Silage Days of Cover" as a national resilience indicator was proposed as a practical first step. (10)

3.2 | Animal Health and Breeding

Artificial insemination (AI) is the most widely deployed intervention for genetic improvement across the states studied. Saamarthya Milk Producer Company deploys approximately 60 trained AI technicians and subsidies the procedure by ₹100 per farmer; with a total cost of ₹250, farmers pay only ₹150., while Uttar Pradesh's Department of Animal Husbandry and Dairying operates three semen stations-at Lucknow, Babugarh, and Lakhimpur-which provide the technical backbone for breed improvement at scale. In Tamil Nadu, CavinKare's R&D team implements a structured crossbreeding programme tailored to agro-climatic conditions, promoting heat-tolerant crossbreds in hotter, drier regions and pure breeds in relatively cooler areas.

Basic animal health and vaccination services are well established within organised dairy value chains. Uttar Pradesh conducts systematic

Foot-and-Mouth Disease (FMD) vaccination twice annually, Heritage Dairy operates six mobile veterinary clinics on fixed monthly schedules, Saamarthya MPC employs ten veterinarians, and CavinKare maintains four in-house veterinarians supported by government and private veterinary service providers. In Maharashtra, Katraj Dairy delivers animal healthcare through a network of veterinarians and para-veterinarians. Despite these institutional efforts, stakeholders consistently highlighted shortages of qualified veterinary professionals as a major constraint, with more than 20,000 sanctioned veterinary posts remaining vacant nationwide, disproportionately affecting farmers outside formal procurement networks.

Consultations across all three states indicate a clear shift in breeding policy toward indigenous and indigenous-dominant crossbreds-particularly Sahiwal, Tharparkar, and Murrah buffalo-reflecting their greater resilience to local climatic conditions, disease pressures, and resource constraints compared with high-yielding exotic breeds. Nevertheless, farmers in some regions continue to favour exotic breeds for their higher milk yields, often without fully accounting for their greater management requirements and increased vulnerability to heat stress and disease.
At the national scale, natural service still covers approximately 65% of India's milch animals, leaving AI coverage at around 30%, while reproductive inefficiencies contribute substantially to productivity losses. Indigenous and non-descript cattle account for roughly 47% of the bovine population but only 22% of milk output, highlighting the potential of selective breeding and technologies such as Genomic Estimated Breeding Values (gEBV) and GauSort sex-sorted semen to improve productivity. RDA members identified joint disease surveillance, vaccination, deworming, and shared animal-health and breeding data systems as priority areas for the next two to three years.

3.3 | Climate-Smart Farm Management

Climate-smart farm management practices are being adopted unevenly across the dairy value chain, with renewable energy and waste management advancing more rapidly than on-farm climate adaptation. Water management, climate-resilient animal housing, and heat-stress mitigation remain at an early stage, largely confined to pilot and demonstration projects.

While basic seasonal measures such as shade structures, sprinklers, and wet gunny bags are practised within some private procurement networks, structured interventions-including improved ventilation, wallow tanks for buffaloes, and evaporative cooling systems-have yet to achieve widespread adoption.



Renewable energy deployment has progressed considerably in dairy processing. CavinKare's Erode plant sources 95-99% of its electricity from wind energy, while its Dindigul plant generates approximately 400 solar units daily. Heritage Dairy is systematically commissioning rooftop solar installations across major processing facilities under 15-year lease agreements, and Katraj Dairy is investing in rooftop solar, water- and electricity-monitoring systems, and piloting electric vehicles for milk logistics.

Water-use efficiency in dairy processing is also improving. Gyan Dairy is working towards the National Dairy Development Board (NDDB) established benchmark with improved efficiency of 0.7-0.8 litres of water per litre of milk processed. CavinKare has further strengthened water stewardship by operating a zero-liquid-discharge system across all its processing plants, enabling treatment and reuse of all wastewaters.

Waste management and biogas represent the most mature and widely adopted climate-smart intervention with direct mitigation benefits. Sistema Bio's national network of approximately 120,000 biogas installations, with Maharashtra as a priority deployment geography, converts dairy waste into clean cooking gas and nutrient-rich organic slurry, simultaneously reducing dependence on Liquid Petroleum Gas and chemical fertilisers. In Maharashtra, Katraj Dairy, in partnership with the IKEA Foundation and NDDB, subsidises household biogas units to around ₹12,000 per farmer (against a full installation cost of approximately ₹30,000-54,000). The model is capable of recovering 40-50% of the investment over time through government incentives and carbon-credit revenues.

At the national level, the March 2026 National Consultation identified circular and decentralised energy as a foundational lever for dairy transformation, with biogas and solar offering lower costs, greater energy resilience, and additional farm revenues. With 192 million milch animals, potential across 70+ million farm households, but only ~120,000 biogas units installed, the opportunity for scale is substantial; the ₹100 crore MNRE Biogas Programme under Phase I of the National Bioenergy Programme (2021–22 to 2025–26) provides a foundation for sustained financing to accelerate adoption and unlock wider economic and climate benefits.

3.4 | Digital and Data Systems

Digital technologies are increasingly strengthening dairy value chains by improving traceability, service delivery, and farmer engagement, although adoption remains uneven across the sector. At the national level, the Government of India's Bharat Pashudhan platform provides the foundational digital infrastructure for animal identification, traceability, productivity monitoring, and data-driven animal health and disease-control services.

At the operational level, private-sector initiatives are considerably more advanced. Heritage Dairy has developed a digital veterinary triage system through which farmers can photograph sick animals and receive first-aid guidance from veterinarians remotely. This is complemented by EcoMilk analysers that provide real-time fat and milk quality measurements, with results communicated directly to farmers via SMS, improving transparency and trust in milk procurement and payment calculations. Saamarthya Milk Producer Company operates a GPRS-based tracking system across approximately 1,500 villages, enabling real-time monitoring of milk volumes and farmer payments, while Gyandhara maintains a database of nearly

80,000 farmers linked to programme interventions and performance outcomes.

Despite these advances, digital adoption outside organised procurement networks remains limited. Animal-level records, productivity data, and emissions-related information are often sparse at the farm level, particularly among smallholders, and digital integration across cooperatives, smaller processors, and government platforms remains fragmented. As a result, the sector has yet to realise the full potential of interoperable digital systems for traceability, advisory services, productivity enhancement, and climate-smart dairy management.

India's dairy digital ecosystem presents significant scope for strengthening productivity and resilience: less than 1% of milch animals are currently covered by structured milk recording, creating a substantial opportunity to improve data for genetic evaluation, emissions accounting, and evidence-based policy. Bharat Pashudhan, with 35.96 crore animals registered under unique Pashu Aadhaar IDs, provides a strong foundation for interoperable data exchange across dairy, breeding, veterinary, and farmer institutions. Building on this foundation, a consolidated farmer-facing application integrating advisory, health alerts, breeding guidance, and payment records could further accelerate digital adoption and service delivery over the next two to three years.



3.5 | Institutional Landscape

The three states represent distinct institutional models for dairy development, reflecting different balances between cooperatives, private processors, and farmer-owned organisations. Tamil Nadu's dairy ecosystem is anchored by Aavin (Tamil Nadu Cooperative Milk Producers' Federation), alongside major private players such as Heritage Dairy, CavinKare, Hatsun Agro Product, and Milky Mist. Maharashtra combines a long-established cooperative network-including Mahanand, Gokul, Katraj, and Warana-with private processors such as Parag Milk Foods, Schreiber Dynamix, and Sonai. In contrast, Uttar Pradesh's organised dairy sector is characterised by a comparatively fragmented cooperative structure, where Milk Producer Companies (MPCs)-including Saamarthya, Gyan, Balinee, Kashee, Harit Pradesh, and Srijanee-alongside private processors such as Ananda and Paras, collectively account for roughly 20% of organised milk procurement in the state.

Government programmes provide the policy backbone for dairy development across all three states. In Uttar Pradesh, the flagship Nand Baba Milk Mission (₹1,000 crore over 2023-2028) aims

to increase annual milk production by more than 25%, complemented by the proposed State Livestock Mission. Tamil Nadu supports the sector through initiatives such as the Milch Animal Loan Scheme and the Buffalo Calves Development Programme, while Maharashtra has introduced programmes including the Chief Minister Animal Health Scheme and the Revised Govardhan Govansh Seva Kendra Yojana.

Collectively, these institutional arrangements and government programmes provide a strong foundation for dairy sector growth and already incorporate several forward-looking provisions relevant to climate resilience.

These models point to a national dairy sector at an inflection point, with growing policy focus on export readiness, quality standards, private-sector participation, and climate-resilient finance, including NABARD's emerging green-lending frameworks. The March 2026 National Consultation highlighted stronger convergence across government, industry, cooperatives, and financial institutions as the key opportunity for scale, while the Resilient Dairy Alliance provides a platform to translate this growing alignment into coordinated action, aligned incentives, and wider adoption of proven practices.

Scheme / State	Core Design Features
Nand Baba Milk Mission (UP)	₹1,000 crore over 5 years, 25-cow indigenous-breed units, DBT incentives, village milk committees with Data Processing Milk Collection Units (DPMCUs).
State Livestock Mission (UP, in design)	Modelled on the National Livestock Mission; to cover feed, farming systems, and breed improvement for indigenous, buffalo, and exotic breeds.
Milch Animal Loan Scheme (TN)	Subsidised loans at 4-7% interest routed through Aavin, TABCEDCO, TAMCO, and cooperative banks.
Buffalo Calves Development Programme (TN)	Calf starter feed, deworming, vaccination, breeding support to grow and stabilise the buffalo population.
Chief Minister Animal Health Scheme (Maharashtra)	Mobile veterinary units delivering doorstep diagnosis, vaccination, AI, and minor surgery since 2017.
Revised Govardhan Govansh Seva Kendra Yojana (Maharashtra)	₹15-25 lakh subsidy per goshala to manage indigenous and non-productive livestock.

Case Study - Saamarthya Milk Producer Company: Farmer Ownership at Commercial Scale

Saamarthya, a farmer-owned Milk Producer Company in Uttar Pradesh with 1.1 lakh member-farmers, illustrates how the MPC model can combine commercial scale with farmer-centricity. The company's turnover is on a trajectory from roughly ₹350 crore (early 2020s) toward a projected ₹750 crore within two years, with 85-90% of revenue returning to farmer-members.

Its operating model layers several of the practices described in this chapter: 60 subsidised AI technicians, village-level delivery of BIS-certified, 22%-protein Type-1 feed developed with Godrej Agrovet and Japfa India, a GPRS-based tracking system across roughly 1,500 villages, and a 10-day payment cycle that anchors farmer trust.

The binding constraint on scaling this model further as shared by stakeholders is not operational but regulatory: Saamarthya, like other MPCs registered under the Companies Act, remains ineligible for subsidies and concessional finance available to registered cooperatives, despite operating on cooperative principles and being wholly farmer-owned.

Case Study - Sistema Bio: Biogas as a Circular Economy Platform

Sistema Bio's model of deploying biogas systems at farm level - demonstrates that reliable, scalable biogas infrastructure is achievable under Indian conditions. Its Pune manufacturing hub operates at capacity of up to 10,000 units per month, confirming that domestic manufacturing is not the binding constraint on scale; the constraint is demand-side - financing mechanisms, and farmer awareness.

The partnership financing model is instructive: private dairies typically cover 80-100% of installation costs directly, while cooperative dairies are supported through CSR funding from partners such as the HCL Foundation, Infosys, and the ICICI Foundation. Katraj Dairy, working with the IKEA Foundation and NDDB, has subsidised installations to approximately ₹30,000 per unit, reducing the farmer's own contribution to roughly ₹12,000.

Sistema Bio also generates 10,000-20,000 Gold Standard carbon credits annually, which help offset farmer adoption costs - though both Sistema Bio and Katraj Dairy report that carbon markets alone remain insufficient to drive adoption at scale, given limited market depth, price volatility, and administrative burden. Carbon finance is best understood as a complementary revenue layer, not a primary driver of scale.

04.

Barriers to Adoption and Scaling

This chapter presents the core analytical findings of the paper. Each barrier is examined using a consistent framework comprising the current situation, evidence from consultations, illustrative examples, and why the barrier limits scaling, enabling readers to compare challenges across themes on a like-for-like basis. The analysis draws directly on the weight, frequency, and consistency with which issues were raised during the state consultations and the National Consultation. To support prioritisation, the table below synthesises all eight barriers, ranking them according to their urgency, severity, and economic impact.



4.1 | Feed and Fodder Constraints

Current Situation

Feed and fodder emerged as one of the largest opportunities to improve productivity and resilience across all three states. Green fodder deficits, seasonal shortages, poor-quality feed, limited silage adoption, weak fodder markets, inadequate regional fodder planning, and shrinking land availability collectively constrain dairy productivity and resilience. National estimates place the overall feed and fodder deficit at 40-50%, while ICAR-IGFRI, Jhansi estimates high-national deficit of 14.1% green, 2.4% dry fodder. Rising temperatures, changing rainfall patterns, more frequent droughts, and increasing competition for land and water are expected to further affect fodder availability and quality.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that silage adoption remains low despite policy support, including Uttar Pradesh's directive promoting the supply of 3 kg of silage per animal per day. Smallholders often lack the capital, infrastructure, and technical knowledge required for cost-effective silage production. Weak fodder markets and the absence of regional fodder planning further limit reliable access to quality fodder, while land scarcity restricts fodder cultivation, particularly in commercially intensive dairy districts.

State-level experiences reinforce these findings. In Uttar Pradesh, stakeholders reported low fodder-crop diversity and limited adoption of improved feeding practices.

In Tamil Nadu, many farmers continue to rely on low-cost feed ingredients such as bran, broken rice, and chunni (the fine outer coating of Pulses, typically generated as a milling by-product and used as a low-cost livestock feed ingredient) rather than quality green fodder, while balanced concentrate feeding remains poorly understood among many producers..

Feed quality presents an equally significant challenge. Stakeholders reported widespread adulteration, including urea mixing and aflatoxin contamination exceeding safe limits. The absence of mandatory compliance of Bureau of Indian Standards or Food Safety and Standards Authority of India standards for cattle feed allows poor-quality feed to circulate in the market, undermining animal productivity while placing manufacturers that voluntarily maintain quality certification at a competitive disadvantage.

Why this Limits Scaling

Feed accounts for nearly 70% of total dairy production costs, making it the single largest determinant of farm profitability. Consequently, interventions that fail to improve feed quality, availability, and nutritional balance are unlikely to generate sufficient economic returns for farmers. This weakens incentives to adopt complementary innovations such as genetic improvement, climate-smart housing, renewable energy, and other productivity-enhancing practices. For this reason, feed and fodder represent not merely one barrier among many, but the foundational constraint whose resolution is essential for scaling climate-resilient dairy systems.

Barrier category	Urgency	Severity / scale	Economic impact	Why it ranks here
Feed & fodder constraints (4.1)	High	High - national deficit of 11-32% green, 23% dry fodder	Very high - feed is~70% of production cost	Single largest, most frequently cited constraint on productivity and cost simultaneously
Farmer adoption & behavioural barriers (4.2)	High	High-affects uptake of every other intervention	High	Determines whether any other fix actually reaches the farm
Extension & capacity constraints (4.3)	Medium	Medium - 20,000+ vacant veterinary posts nationally	Medium	Root cause of both animal-health and adoption gaps
Animal health & genetics (4.4)	Medium	Medium-disease burden, limited AI coverage	medium	Directly suppresses yields and reproductive performance
Access to finance (4.5)	High	Medium-High - financial products and delivery mechanisms remain an opportunity for smallholder dairy investment needs	High	Capital gap blocks conversion of subsidy entitlement into installed assets
Market & value chain constraints (4.6)	Medium	Medium - no premium for climate-smart milk	High	Removes the demand-side incentive for all upstream investment
Data & digital gaps (4.7)	Medium	Foundational-underlies traceability, MRV, targeting	Medium	Low visibility today, but blocks future financing and reporting systems
Policy & institutional challenges (4.8)	Medium	Medium - systemic, affects delivery of all schemes	High	Fragmentation dilutes the impact of otherwise well-designed programmes

4.2 | Farmer Adoption and Behavioural Barriers

Current Situation

Farmer adoption remains one of the most significant barriers to scaling climate-resilient dairy practices. While most farmers are aware of good animal husbandry practices such as deworming, vaccination, and balanced feeding, awareness alone does not consistently translate into behavioural change. Instead, limited understanding of climate risk, high perceived investment risk, poor record-keeping, weak demonstration of economic benefits, and insufficient follow-up after training collectively constrain the adoption of improved management practices.

Evidence from Consultations and Illustrative Examples

Consultations consistently revealed that farmers readily recognise changing climatic conditions-including hotter summers, shifting rainfall patterns, and altered crop cycles-but often do not connect these observations with the need to modify livestock management practices.

Gyan Dairy's field teams reported that although most farmers can correctly describe recommended practices, many revert to traditional methods once extension support or handholding is withdrawn.

Affordability further reinforces risk aversion. Smallholders managing only two to four animals typically have limited disposable income and cannot readily invest in climate-smart technologies such as silage bunkers, improved animal housing, sprinklers, or biogas systems. Many are also reluctant to adopt practices that may temporarily reduce milk yields during the transition period. Poor farm-level record-keeping compounds this challenge. Without reliable records on milk production, feed use, animal health, or costs, neither farmers nor extension providers can clearly demonstrate the economic returns from improved practices, weakening confidence in new technologies and management approaches.

Regional socio-cultural factors also influence adoption. In Tamil Nadu, farmers are generally more receptive to commercial milk marketing and improved fodder practices. In contrast, consultations in Uttar Pradesh highlighted persistent social preferences for exotic cattle breeds, which are often perceived as symbols of higher status despite being less resilient to local climatic conditions. Stakeholders also emphasised that although women perform a majority of dairy-related labour, they frequently lack formal authority to access credit, make investment decisions, or enter into financial agreements, limiting household adoption of improved practices.

RDA discussions strongly reinforced that scaling innovation in dairy is ultimately less about finding new solutions and more about building farmer confidence to adopt them.

Farmers need to see that a practice works, understand its benefits, and have trusted support through the transition. Shreeja MPC noted that farmers may take two to three years of seeing successful results among their peers before adopting a new practice, while Godrej Agrovet highlighted basic gaps in feeding, calf management, and record-keeping. Cargill pointed to farmer education and resistance to changing established practices as key barriers, while ITC highlighted weak market linkages and fragmented supply chains that make sustained adoption harder.

Why this Limits Scaling

Farmer adoption is fundamentally a behavioural and trust challenge rather than simply an information gap. Interventions that rely solely on awareness campaigns, training sessions, or standalone digital tools are therefore unlikely to achieve sustained adoption. Instead, continued extension support, trusted local advisory services, demonstration of tangible economic benefits, and improved farm-level record-keeping are essential to building farmer confidence and reducing perceived risk. Because this barrier influences feed adoption, breed improvement, access to finance, and digital technology uptake, it functions as a keystone constraint whose resolution would generate positive spillover effects across multiple barriers.



Why Digital and New-Age Interventions Often Underperform in Rural Contexts

A recurring pattern across the consultations is that purely digital or 'new-age' interventions struggle where they are not embedded in an existing relationship of trust and local customisation. Heritage Dairy's digital triage system works precisely because it sits inside an established veterinary and procurement relationship, not as a stand-alone app. Gyandhara's extension model - built on repeated, structured village-meeting content delivered by trusted local staff rather than one-off digital push - is what converts awareness into sustained practice change. The consistent lesson: digital tools amplify extension that already has local trust; they do not substitute for it. This has direct implications for how future digital-advisory and fintech pilots should be designed and sequenced.

4.3 | Extension and Capacity Constraints

Current Situation

Extension and veterinary capacity remain critical bottlenecks to scaling climate-resilient dairy systems in India. A limited veterinary workforce, shortages of extension personnel, weak last-mile advisory services, inadequate institutional technical capacity, and insufficient farmer handholding collectively constrain the delivery of animal health, breeding, nutrition, and climate advisory services, particularly in remote and underserved areas.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that India faces a severe shortage of trained animal health and extension personnel relative to the size and geographic dispersion of its dairy farming population. With more than 20,000 sanctioned veterinary posts remaining vacant nationwide, the capacity to provide animal health services, artificial insemination (AI) guidance, disease surveillance, and climate advisory at the frequency required simply does not exist across much of the country.

To address this gap, several organised dairy value chains have established their own extension systems. Heritage Dairy and Saamarthya Milk Producer Company have built dedicated veterinary teams that provide regular animal health and advisory services to farmers within their procurement networks. However, smallholders operating outside these organised systems generally lack access to comparable support. In Maharashtra, Katraj Dairy relies extensively on para-veterinarians to expand service coverage, but stakeholders noted that this approach also carries risks, including inappropriate antibiotic use arising from limited technical supervision.

Extension delivery models themselves were also identified as a major constraint. Across most regions, advisory services continue to rely on periodic village camps or one-off awareness programmes, which have proven insufficient to sustain behavioural change or support the adoption of climate-resilient practices. In contrast, Gyan Dairy's structured extension approach-built around the repeated messaging framework of "Right Breeding, Right Feeding, Right Education"

and delivered through regular village chaupals (community-based farmer meetings that provide practical extension and advisory support on breeding, feeding, animal health, and dairy management) was widely cited (by other stakeholders) as an effective model for fostering continuous farmer engagement and practice adoption.

Why this Limits Scaling

Extension and veterinary services constitute the primary delivery mechanism through which virtually every technical intervention discussed in this paper-including feed optimisation, breed improvement, disease control, digital advisory services, and climate smart housing-reaches farmers. Without sustained technical support and trusted local advisory relationships, even well-designed policies and technologies fail to achieve widespread adoption. Consequently, underinvestment in extension and veterinary capacity. places a ceiling on the effectiveness and scalability of every other intervention, making it one of the most fundamental constraints to building climate-resilient dairy systems.

4.4 | Animal Health and Genetics

Current Situation

Animal health and genetic improvement remain fundamental determinants of dairy productivity and climate resilience. However, disease burden, limited access to artificial insemination (AI), the high cost of improved genetics, reproductive challenges associated with heat stress, and weak disease surveillance systems continue to constrain progress, particularly among smallholders outside organised dairy procurement networks. The scale of the breeding challenge is reflected in national data from the Department of Animal Husbandry and Dairying (DAHD): AI coverage extends to only around 33% of breedable bovines nationally, while approximately 70% are covered through scrub bulls of unknown genetic merit. This limits the pace at which high-genetic-merit breeding can reach the wider dairy population.

Sex-sorted semen represents an important next step in genetic improvement, enabling the production of female calves with more than 90% accuracy and potentially improving the economic efficiency of dairy breeding. DAHD has therefore incorporated sex-sorted semen into the Rashtriya Gokul Mission and provides a subsidy of ₹750 or up to 50% of its cost to participating farmers.

Yet the technology remains at an earlier stage of deployment than conventional AI: DAHD's 2024–25 Annual Report records 55.88 lakh doses produced through government semen stations and a further 57.33 lakh doses through milk federations, NGOs and private semen stations, while the programme envisages 51 lakh pregnancies through sex-sorted semen.

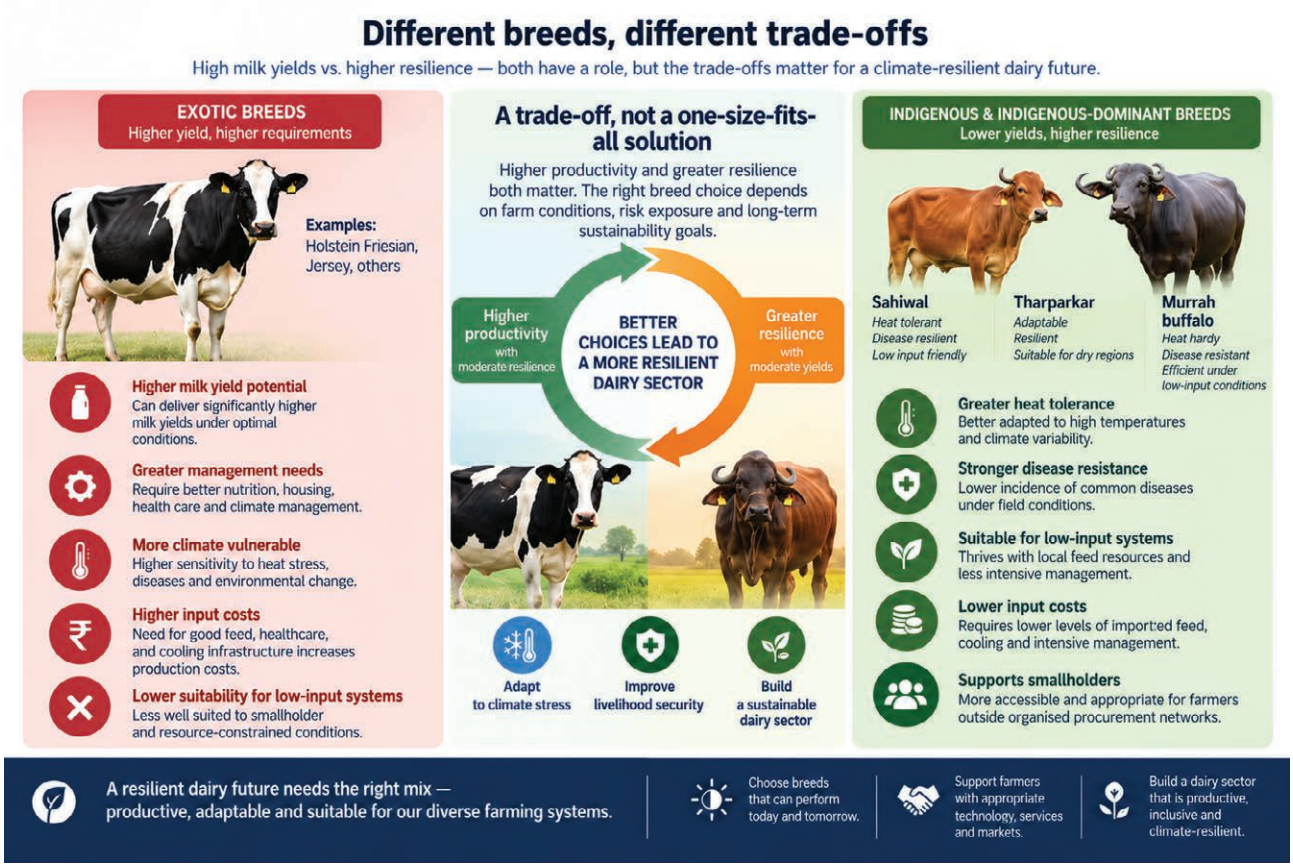
Evidence from Consultations and Illustrative Examples

Consultations highlighted that climate variability is increasing both the frequency and severity of animal health challenges. Stakeholders frequently cited the 2023–24 Lumpy Skin Disease (LSD) outbreak, highlighted by the Kumaraguru Institute, as a major example of how climate-related disease outbreaks can cause widespread livestock mortality, reduce milk production, and impose significant economic losses across multiple states. Participants also reported rising incidences of respiratory, digestive, and vector-borne diseases associated with increasing temperatures and changing climatic conditions.

While AI services are relatively well established within organised dairy value chains, access remains substantially weaker outside formal

procurement networks, and the cost of improved genetics continues to be a barrier for many smallholders. Consultations also reinforced a growing policy and stakeholder consensus favouring indigenous and indigenous-dominant crossbreds-particularly Sahiwal, Tharparkar, and Murrah buffalo which offer greater resilience to heat stress, disease pressure, and low-input production systems than high-yielding exotic breeds. Nevertheless, many farmers continue to prefer exotic breeds because of their higher milk yield potential, often underestimating their greater management requirements and climate vulnerability.

Stakeholders further noted that heat stress adversely affects reproductive performance, reducing conception rates and overall breeding efficiency. At the same time, existing animal disease surveillance systems remain insufficiently integrated and lack the coverage needed to provide timely early warning and rapid response at the scale required for an increasingly climate-vulnerable dairy sector.



Why this Limits Scaling

Animal health and genetic improvement generate cumulative benefits over long time horizons. Breed improvement programmes require multiple generations to substantially alter herd composition, while disease prevention depends on sustained investments in veterinary services, vaccination, surveillance, and AI delivery. Delays in strengthening breeding programmes, expanding AI coverage, or improving disease surveillance therefore have long-lasting consequences, resulting in foregone productivity and resilience gains that are difficult to recover later. Without parallel investment in veterinary capacity and surveillance systems, the benefits of improved genetics are continually undermined by disease losses, poor reproductive performance, and inconsistent follow-through in breeding programmes.

4.5 | Access to Finance

Current Situation

Access to finance remains a major constraint to the adoption of climate-smart dairy practices. Limited availability of dairy-specific credit products, high upfront investment costs, weak banking linkages, inadequate insurance coverage, limited blended finance mechanisms, and structural barriers faced by smallholders collectively restrict investment in climate-resilient infrastructure. Existing financial products are generally not designed to match the cash-flow characteristics or capital requirements of dairy farming.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that formal credit products are poorly aligned with the realities of smallholder dairy production. Smallholder dairy households often have limited and irregular cash flows and constrained availability of capital, making it difficult to meet fixed monthly loan repayments and finance upfront investments. Fixed monthly loan repayments often do not correspond with the bi-monthly or seasonal income patterns of dairy households, while many farmers lack the collateral, documentation, or credit history required to access institutional finance.

Limited access to formal financial institutions further constrains their ability to access credit or build the capital required to invest in their dairy enterprises.

An example raised during consultations was the non-disbursement of the 35% bank-loan component under Uttar Pradesh's Nand Baba Milk Mission. Although farmers have contributed their required 15% share and the state has committed its 50% subsidy, documentation gaps, procedural delays, and weak convergence between government departments and banking institutions have prevented the final bank-financed component from reaching beneficiaries. As a result, the effective financial support delivered to farmers falls well below the scheme's intended value. For smallholders with limited own capital and cash-flow buffers, such delays can further constrain their ability to make the required investments.

Stakeholders also highlighted structural inequities affecting institutional finance. Milk Producer Companies (MPCs) registered under the Companies Act remain largely excluded from subsidy programmes and concessional financial schemes available to registered cooperatives, despite operating on cooperative principles and being wholly farmer-owned (see Box, Section 3.5). In addition, the substantial upfront investment required for climate-smart technologies-including biogas plants, climate-resilient livestock sheds, silage infrastructure, and water-management systems-remains beyond the reach of most smallholders with limited access to their own capital or formal credit without dedicated subsidy support or concessional financing.

A promising example is Saamarthya MPC's Memorandum of Understanding with Indian Bank, which provides collateral-free Dairy Kisan Credit Card (KCC) loans of up to ₹2-3 lakh at approximately 7% interest. While this model demonstrates how financial products can be better tailored to dairy producers, stakeholders noted that its coverage currently extends to only a small proportion of the eligible farmer population. Expanding such mechanisms could help address the underlying gap in access to formal financial institutions and capital faced by smallholder dairy farmers.

Why this Limits Scaling

Finance is the critical mechanism that converts farmer willingness into sustained investment and adoption. Without accessible, appropriately designed financial products, smallholders are unable to invest in climate-smart infrastructure such as biogas units, silage bunkers, improved livestock housing, or water-efficient technologies. Equally important, farmers need access to working capital to meet the recurring operating costs associated with these interventions, including feed and fodder, animal health and breeding services, maintenance of equipment and infrastructure, energy, water, and other farm-level inputs. Moreover, when government programmes rely on bank-loan components that are not reliably disbursed, farmer confidence in public schemes declines and adoption slows. Unless financial systems are better aligned with dairy cash flows and cover both the upfront capital expenditure and ongoing operating requirements of climate-resilient technologies and practices, many of the interventions proposed in this paper will remain beyond the reach of the majority of smallholder dairy farmers.



4.6 | Market and Value Chain Constraints

Current Situation

Market and value chain incentives for climate-resilient dairy production remain weak. Limited aggregation, uneven market access, the absence of sustainability-linked price premiums, widespread feed-quality issues, and the continued dominance of informal marketing channels constrain the demand-side case for adopting climate-smart practices. As a result, farmers receive little or no direct market reward for investing in more sustainable production systems.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that no market-level incentive currently exists for climate-resilient dairy practices. Farmers who adopt heat-tolerant indigenous breeds, install biogas units, improve fodder management, or produce silage generally receive the same milk procurement price as those who continue with conventional production practices. Consequently, the financial justification for adopting these practices depends almost entirely on reductions in production costs or improvements in productivity-benefits that are real but often gradual and insufficient to offset substantial upfront investment costs.

Prevalence of poor-quality feed further illustrates broader market failures. In the absence of mandatory compliance of BIS or FSSAI quality standards for cattle feed, manufacturers that voluntarily maintain higher quality standards-including stricter aflatoxin limits and BIS certification-must compete with lower-cost poor quality products on an uneven playing field, reducing incentives for quality improvement across the sector.

Stakeholders also highlighted the growing challenge posed by counterfeit and analogue dairy products. Some stakeholders cited the example of analogue paneer being sold for approximately ₹180 per kilogram, substantially undercutting genuine paneer, which costs around ₹280–300 per kilogram to produce. Such products not only create unfair competition for legitimate dairy processors but also raise concerns regarding consumer misinformation and product authenticity.

Finally, consultations noted that a significant proportion of milk continues to be marketed outside formal procurement systems. This limits the ability of organised processors and cooperatives to encourage sustainable production practices through procurement relationships, as farmers can readily shift to informal buyers when procurement conditions or quality requirements become less favourable.

Why this Limits Scaling

Without a clear market signal or price premium linked to climate-resilient production, the economic rationale for farmer investment depends almost entirely on long-term cost savings and productivity improvements. While these benefits are important, they are generally slower and less visible than direct financial incentives and are often insufficient to justify the upfront capital required for interventions such as improved housing, biogas systems, or fodder infrastructure. Consequently, adoption remains heavily dependent on subsidies, donor funding, CSR initiatives, or company-led programmes, making the transition less self-sustaining and limiting the scalability of climate-smart dairy practices across the sector.

4.7 | Data and Digital Gaps

Current Situation

Limited animal-level records, weak productivity data, inadequate emissions measurement, poor digital integration, and persistent traceability challenges continue to constrain evidence-based decision-making across India's dairy sector. While a few leading private-sector organisations have begun investing in digital platforms and data systems, systematic data collection remains sparse outside organised procurement networks, limiting both farm-level management and sector-wide planning.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that most farms, particularly those outside formal procurement systems, maintain little or no systematic animal-level data on births, lactation cycles, milk yields, feed use, health events, or reproductive performance. Even within organised procurement networks, record-keeping is often inconsistent, reducing the ability of farmers, extension agencies, processors, and policymakers to accurately assess productivity, demonstrate the economic benefits of improved practices, target interventions, or support financing decisions.

Emissions measurement and greenhouse gas (GHG) accounting are also at a relatively early stage of development. Stakeholders noted that organisations such as Gyandhara, CavinKare, and Gyan Dairy have initiated work on methane reduction assessment, carbon-footprint estimation, and GHG accounting. However, these efforts remain exploratory and project-specific, with no widely accepted, standardised methodology that enables comparison across organisations or value chains.

Consultations also highlighted an important lesson for digital transformation. Several stakeholders observed that digital and "new-age" technologies often struggle to achieve sustained adoption in rural contexts unless they are both locally relevant and supported by trusted extension relationships. Heritage Dairy's EcoMilk analysers were frequently cited as an example of successful digital adoption because they enhance transparency by providing farmers with real-time fat and milk-quality readings via SMS, thereby strengthening confidence in procurement and payment calculations. In this case, stakeholder trust and transparency were viewed as equally important as the technology itself (see Section 5.4).

Why this Limits Scaling

Reliable data underpin nearly every aspect of a climate-resilient dairy system. Financiers require farm-level information to assess credit risk and develop tailored financial products; processors need reliable productivity and quality data to strengthen procurement and advisory services; policymakers depend on accurate information to target subsidies and monitor programme performance; and regulators, buyers, and export markets increasingly require credible evidence to verify sustainability and emissions claims. Without robust, standardised, and interoperable data systems, financing remains generic rather than responsive to farmer needs, climate interventions cannot be effectively targeted or evaluated, and sustainability claims cannot be independently verified.



Sequencing Note: Foundational Data Gaps must be Closed First

Farmer awareness and basic record-keeping - animal identification, productivity records, health history - are not simply one item on the data agenda; they are the foundation on which every more advanced system depends. Traceability, Measurement, Reporting and Verification (MRV) for climate financing, and targeted service delivery cannot function reliably without this base layer. The practical implication is sequencing: investment in farmer-level records and animal identification should precede, or at minimum run in parallel with, more advanced traceability, emissions-reporting, and digital-platform investments, rather than treating them as a single undifferentiated 'digital and data' priority.

4.8 | Policy and Institutional Challenges

Current Situation

Policy and institutional arrangements for climate-resilient dairy development remain fragmented, with responsibilities dispersed across multiple departments and agencies that do not consistently coordinate. Weak convergence between institutions, limited integration of climate considerations into programme design, regulatory bottlenecks, and the uneven access to public schemes and institutional support across different dairy organisations—including cooperatives, Milk Producer Companies (MPCs), and private-sector actors—canreduce the effectiveness of public interventions and increase the complexity of accessing support.

Evidence from Consultations and Illustrative Examples

Consultations consistently highlighted that farmers must engage separately with multiple institutions-including State Animal Husbandry Departments, Dairy Development Boards, Agriculture Departments, banking institutions, and renewable-energy agencies-to access veterinary services, dairy development schemes, credit, fodder programmes, and renewable-energy initiatives. This fragmented institutional landscape creates significant transaction costs, particularly for smallholders with limited time, resources, and administrative capacity.

In Uttar Pradesh, the Dairy Development Board confirmed that the block-level coordination committees proposed under the Nand Baba Milk Mission to improve local governance and interdepartmental convergence are yet to become operational, limiting coordination at the implementation level.

Stakeholders also observed that although several government programmes contain elements that contribute to climate resilience, climate adaptation and mitigation objectives are not yet systematically embedded within programme design, implementation, monitoring, or evaluation frameworks. Breed improvement programmes do not consistently prioritise climate-resilient indigenous and indigenous-dominant breeds, while feed and fodder initiatives generally lack explicit climate adaptation targets. Consultations in Uttar Pradesh also identified a policy gap whereby existing government schemes support only the induction of indigenous breeds, with no dedicated programme for high-yielding exotic or crossbred cattle despite the state's position as India's largest milk producer.

A further institutional concern relates to the policy treatment of farmer-owned organisations. Milk Producer Companies continue to operate at a structural disadvantage compared with registered cooperatives, despite functioning on cooperative principles and often demonstrating comparable or stronger farmer-centric governance. Stakeholders also pointed to an untapped opportunity for greater convergence between the dairy sector and India's approximately ₹1.78 lakh crore annual chemical fertiliser subsidy programme, particularly through the promotion of organic fertilisers derived from dairy waste as part of a circular economy approach.

Why this Limits Scaling

Institutional fragmentation acts as a multiplier of every other barrier identified in this chapter. It is one of the primary reasons that well-designed financial schemes experience implementation delays (Section 4.5), why extension and

veterinary services are not effectively integrated with financial and advisory support (Section 4.3), and why climate resilience has yet to be systematically mainstreamed across dairy development programmes. When farmers are required to navigate multiple, uncoordinated institutional channels to access complementary services, the effectiveness of interventions in feed, breeding, finance, extension, and renewable energy is substantially reduced. Strengthening policy convergence and embedding climate resilience across programme design and implementation are therefore essential for achieving scalable and coordinated transformation of the dairy sector.

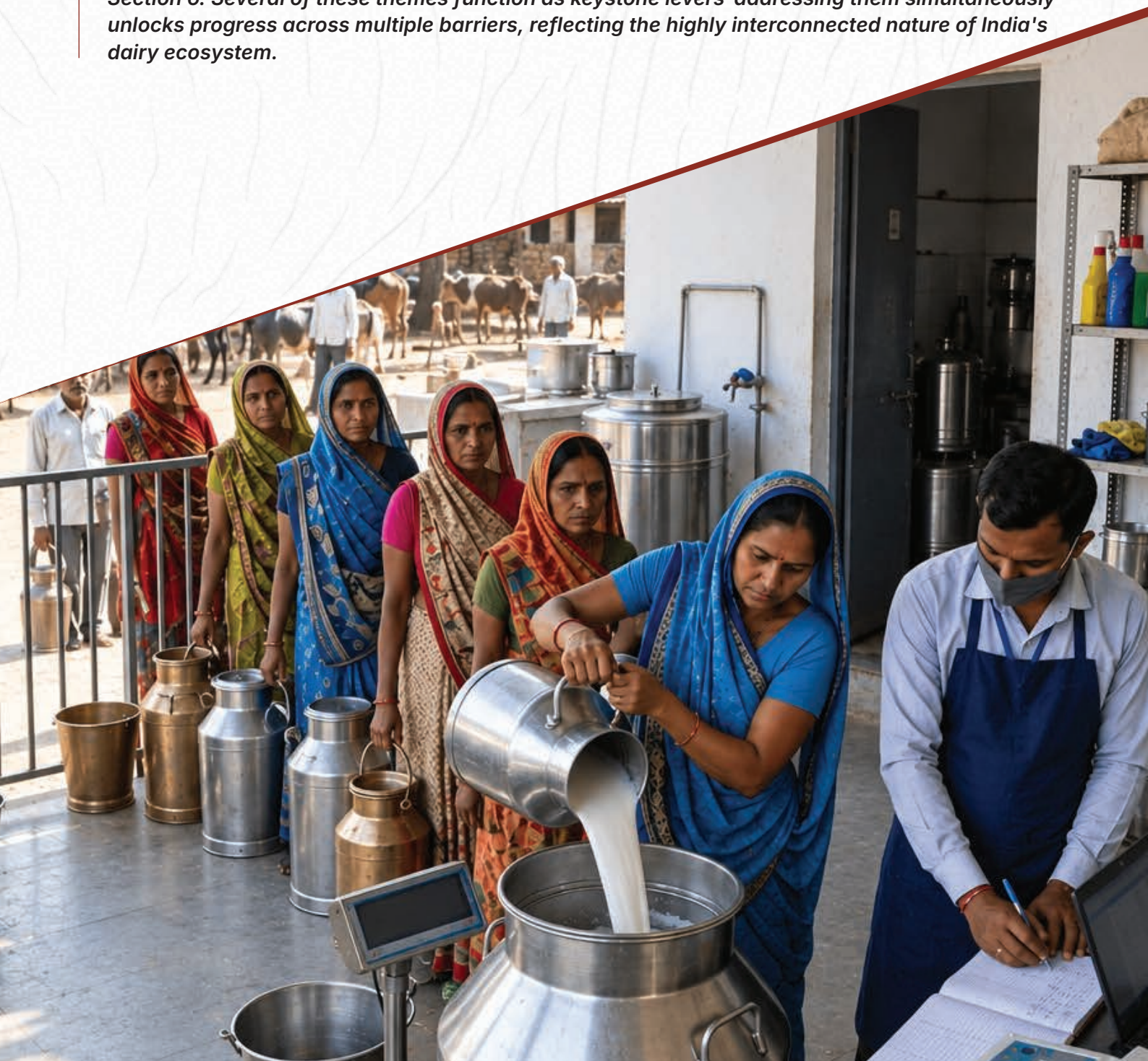
The Nand Baba Milk Mission is, on paper, one of the most comprehensive state dairy schemes reviewed in this paper: a ₹1,000 crore outlay over five years (2023–24 to 2027–28), combining capital subsidy, breed improvement, direct benefit transfers, and village-level governance structures.
Yet the scheme's implementation experience also highlights the finance and institutional barriers described above. Its financing structure requires a 50% state subsidy, a 15% farmer contribution, and a 35% bank loan. While the state subsidy has been allocated and farmers have contributed their share, the bank-loan component has faced delays, leaving some farmers who have already invested unable to complete their planned investments.

The Dairy Development Board of Uttar Pradesh attributes these delays to documentation gaps and weak coordination between government agencies and banking institutions, reflecting the institutional fragmentation described in Section 4.8.
The experience illustrates this paper's central finding: the constraint is rarely the absence of a well-designed policy; rather, it is often the delivery architecture required to translate that policy into implementation.

05.

Key Insights Emerging from the Consultations and RDA Discussions

While Section 4 examined the principal barriers to scaling climate-resilient dairy systems, this chapter synthesises the broader strategic insights that emerged consistently across the state consultations, National Consultation, and discussions under the Resilient Dairy Alliance (RDA). Rather than introducing new barriers, these insights identify the underlying principles that should shape the design, sequencing, and implementation of the recommendations presented in Section 6. Several of these themes function as keystone levers-addressing them simultaneously unlocks progress across multiple barriers, reflecting the highly interconnected nature of India's dairy ecosystem.



5.1 | Productivity is the Foundation of Climate Resilience in Indian Dairy

Across every consultation, stakeholders consistently identified productivity improvement as the most practical and immediate pathway for strengthening climate resilience. Climate resilience was viewed not as a separate agenda from productivity, but as a direct consequence of improving production efficiency. With land and natural resources already under increasing pressure, participants agreed that India's dairy sector must focus on closing the substantial gap between current milk yields and global productivity benchmarks.

This approach also delivers significant climate benefits. As several stakeholders, including Sonai Dairy, noted, higher milk yield per animal reduces greenhouse gas emission intensity per litre of milk produced because fewer animals are required to generate the same output, thereby lowering enteric methane emissions per unit of production. The National Consultation (Session 2) described this as a "triple win": productivity-led interventions simultaneously increase farmer incomes and livelihood security, strengthen national food security, and improve climate mitigation and adaptation outcomes.

5.2 | Feed and Fodder Systems are the Single Largest Opportunity for Transformation

Feed and fodder systems emerged as the most consistently cited determinant of productivity, profitability, and climate resilience across all consultations. Accounting for nearly 70% of total dairy production costs, feed represents the single largest leverage point for improving farm economics while simultaneously reducing emissions intensity.

Stakeholders repeatedly highlighted several proven but underutilised interventions-including balanced feeding, mineral supplementation, regular deworming, improved fodder cultivation, and silage adoption-that remain constrained not by technological limitations but by inadequate extension support and inconsistent follow-up. Participants noted that simple interventions such as regular deworming and mineral supplementation can improve milk yields by up to 20% without increasing feed costs, yet adoption remains uneven because farmers rarely receive sustained advisory support (Sections 4.2 and 4.3).

For these reasons, improving feed availability, quality, and management was consistently identified as the intervention most likely to deliver simultaneous gains in productivity, production costs, farmer profitability, and climate resilience. This is the reason why feed and fodder are prioritised as both the highest-ranked barrier in Section 4.1 and the first recommendation in Section 6.



5.3 | Adoption Depends on Farmer Economics and Institutional Trust, Not Technology Alone

Across consultations, stakeholders consistently emphasised that farmers adopt new practices when there is a clear economic rationale, manageable risk, visible return on investment, and trusted institutional support-not simply because a technology is technically superior. Financial confidence, payment reliability, repeated engagement, and effective last-mile extension were repeatedly identified as stronger determinants of sustained adoption than technological sophistication alone.

The clearest illustration is payment discipline. CavinKare's weekly farmer payments and Heritage Dairy's consistent 10-day payment cycle, complemented by annual loyalty bonuses for consistent suppliers, were both cited as important drivers of farmer trust and long-term supplier retention. These practices require relatively little additional technology or capital investment yet demonstrate how institutional reliability can be as important as technical innovation in strengthening farmer relationships and encouraging continued participation in organised procurement systems.

The same principle applies to climate-smart investments. Technologies requiring substantial upfront expenditure but offering uncertain or delayed returns tend to experience low adoption, whereas interventions with clearly demonstrated productivity or income benefits spread more rapidly.

Stakeholders also observed that women farmers, once convinced of a practice's benefits through visible productivity improvements, often demonstrate strong adherence to improved practices. Gyandhara's field experience indicated that women farmers were less likely to revert to previous practices after observing tangible improvements, contributing to more stable production outcomes and more reliable milk supply.

Effective extension is critical to converting this initial willingness into sustained behaviour change. Consultations reinforced that digital tools can extend—but cannot replace—trusted extension systems and continued farmer engagement. Successful climate-smart interventions require locally relevant advice, repeated interactions, practical demonstrations, and handholding through the adoption process. Gyan Dairy's Gyan Choupal model illustrates this approach by combining village-level farmer interactions with field-based extension and veterinary support, providing guidance on breeding, feeding, animal health, clean-milk production and dairy management. Similarly, Heritage Dairy's digital veterinary triage system and EcoMilk analysers have generated value not simply through the technology itself, but through the accompanying advisory support and transparent SMS communication of milk-quality results, which helps build confidence in procurement and payment systems.

Farmer economics also cannot be separated from the wider cropping system. Dairy production in India is fundamentally integrated with crop cultivation: crop residues provide livestock feed, while livestock manure and biogas slurry can return nutrients to agricultural land. Examples such as Mittal Farm's integration of vermicompost and Jeevamrit-a fermented, farm-made microbial preparation used as an organic soil-input-production with organic vegetable cultivation, and the development of biogas-slurry fertiliser markets by Katraj Dairy and Sistema.bio, demonstrate how circular-economy approaches can create additional income and productivity benefits rather than treating livestock waste solely as a disposal problem. Stakeholders also highlighted India's approximately ₹1.78 lakh crore annual chemical fertiliser subsidy as a significant, but largely untapped, opportunity to integrate dairy-derived organic fertilisers within existing agricultural policy and incentive structures.

5.4 | Multi-Stakeholder Partnerships are Essential for Scaling

No single organisation possesses the resources, expertise, or institutional mandate required to overcome the barriers identified in Section 4. Effective scaling therefore depends on coordinated partnerships among government agencies, dairy companies, financial institutions, producer organisations, research institutions, civil society organisations, and development partners.

The Resilient Dairy Alliance itself represents the clearest institutional example of this collaborative approach. Its Technical Working Groups enabled detailed discussions on specialised themes-including feed systems, finance, and digital infrastructure-while maintaining broader consensus across stakeholders. Participation by institutions such as NABARD (it was part of the discussion during the national consultation) further demonstrated how integrating financial institutions within multi-stakeholder platforms can directly connect financial product design with field-level constraints identified during consultations.

Gyandhara: Extension at the Scale that Trust Requires

Gyandhara, a cattle feed manufacturer and farmer-extension company operating across Uttar Pradesh and North-East India, offers one of the most concrete illustrations of Insight 5.4. Its model rests on dedicated technical staff conducting 10-12 village meetings per day, reaching approximately 500 farmers daily, and maintaining a database of 80,000 farmers linked to intervention outcomes.

The results are measurable: in catchments where improved feed was introduced alongside this extension model, Gyandhara reports doubling or tripling of yields, and, notably, that once a woman farmer sees a concrete yield improvement, she does not revert to prior practice.

Opportunity for scale: Gyandhara's model can be strengthened further by integrating government scheme facilitation, Kisan credit card loan processing, insurance registration, vaccination records, into its existing village-meeting structure, reducing the coordination burden that Section 4.8 identifies as a systemic barrier, without requiring farmers to navigate a separate institutional window.

Project-level experiences reinforce the same lesson. Sistema Bio's partnership model succeeds because financing responsibilities are shared across private dairies, CSR partners including the HCL Foundation, Infosys Foundation, ICICI Foundation, NDDB, IKEA Foundation, and producer organisations, creating funding mechanisms that no individual institution could provide independently. These experiences highlight several transferable principles: building trust through a shared evidence base; using technical working groups for focused problem-solving; combining public policy with private-sector implementation capacity; and maintaining continuous stakeholder engagement rather than relying on one-off consultations.

5.5 | Data Should Become a Strategic Asset for the Dairy Sector

Stakeholders consistently viewed better data systems as a strategic prerequisite for transforming India's dairy sector rather than simply an administrative requirement. Reliable farm- and animal-level data underpin effective planning, productivity improvement, traceability, financing, programme monitoring, sustainability reporting, and future access to climate finance.

Mitigating GHG (particularly methane) emissions helps farmers access the carbon credits market, and other climate financing solutions. Beyond generic emission factors, it worth considering an India-relevant accounting approach, reflecting the diversity of production systems and local data available.

India already possesses important elements of a national digital architecture through platforms such as Bharat Pashudhan, while the RDA knowledge platform launched in 2026 seeks to facilitate knowledge exchange, document field experiences, and disseminate innovations across geographies. However, consultations emphasised that these systems cannot achieve their intended potential without consistent collection of farmer- and animal-level data and greater interoperability across institutions.

Kumaraguru Institute: Decentralised Rural Entrepreneurship

Kumaraguru Institution's "Rural Mart Plus Fellowship" model supported by Environmental Defense Fund (EDF), with 10 rural marts now operational across seven districts of Tamil Nadu and serving more than 7,000 farmers, demonstrates a decentralised alternative to centralised service delivery. Each rural mart is run by a local entrepreneur who undergoes three months of structured training by Kumaraguru institutions, covering technical dairy farm management and business skill development. This is followed by two years of mentorship and fellowship support, enabling entrepreneurs to build sustainable rural enterprises while providing farmers with reliable, last-mile access to agricultural and dairy services.

By placing trained entrepreneurs within rural communities, the model helps address gaps in last-mile extension, technical advisory services and access to agricultural and dairy inputs and services, while simultaneously creating local livelihood opportunities through entrepreneurship. The model is also being adapted for Maharashtra, demonstrating its potential transferability across different dairy and agricultural ecosystems. It reflects the kind of academic institution-led, policy co-development and farmer–extension partnership that EDF's broader engagement with Kumaraguru has supported.

Opportunity for scale: Consultations suggest that redirecting a portion of public funding currently allocated to large, centralised projects toward smaller, decentralised rural service units could significantly expand local outreach. With an estimated ₹8–10 lakh investment required to establish a rural mart, the model offers a relatively cost-effective approach to creating village-level service and entrepreneurship hubs. Scaling such units could strengthen last-mile service delivery, generate local livelihoods, create rural employment, and promote community-based service provision rather than concentrating resources in a limited number of centralised facilities.

5.6 | Youth Engagement as a Long-term Sustainability Strategy

The importance of attracting and retaining youth in the dairy sector was highlighted as a critical long-term priority. Members observed that the ageing farmer population and declining interest of younger generations in dairying could pose a significant challenge to the sector's future and is a critical element for sustainability. It was noted that youth will play a crucial role in driving technology adoption, innovation, climate resilience, and productivity improvements and the long-term continuity of the dairy sector.



06.
Policy Recommendations

This chapter translates the barriers (Section 4) and insights (Section 5) into actionable recommendations. Each recommendation names the issue it addresses, the institutions best placed to lead it, and the outcome it is expected to deliver. Recommendations are grouped thematically below (6.1–6.7); Table below additionally maps a subset of high-leverage actions by the actor best positioned to lead them - distinguishing what individual MPCs and smaller dairies can act on directly from what requires large dairy companies, financial institutions, or government - and flags foundational, low-cost 'quick win' actions that can build momentum for longer-term transformation.

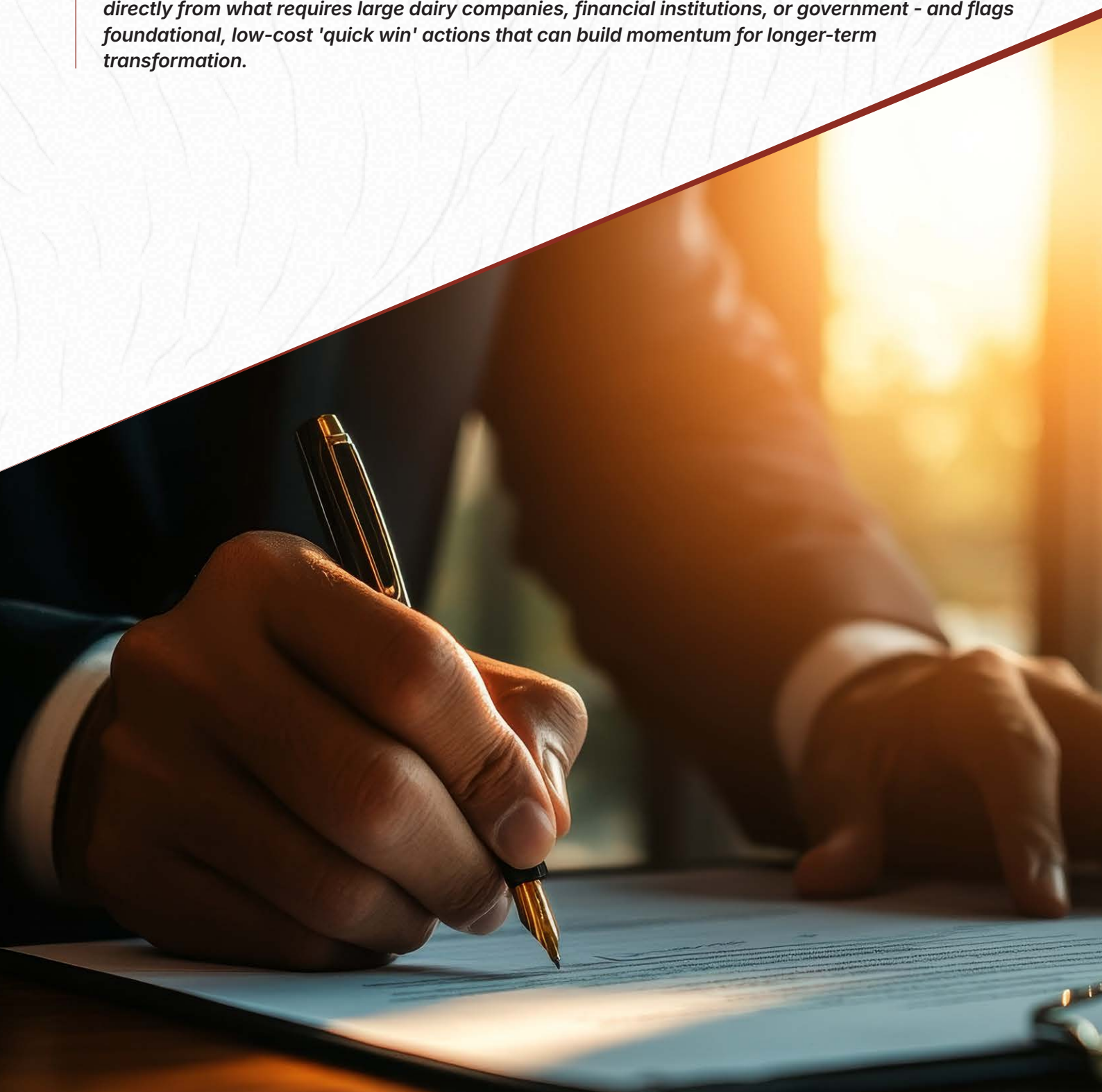


Table 2: Policy Recommendations

Action	Nature	Best-Placed Actor(s)
Establish farmer-level record-keeping and animal identification systems	Foundational-precondition for traceability, MRV, and targeted finance	MPCs and smaller dairies; NDDB / Bharat Pashudhan as platform
Establish structured bank-facilitation mechanisms for dairy credit	Foundational, systemic - converts subsidy entitlement into disbursed capital while aligning loan repayment schedules with seasonal milk cash flows (avoiding recover stress during dry/lean periods)	NABARD, State-Level Bankers' Committees, NDDB
Develop a National Fodder Security Policy	Structural — bundles NLM and AHIDF through single-window appraisal; mandates district fodder calendars. Promotes climate-resilient perennial fodder crops, silage banking, protects common grazing lands to prevent land-use conflicts for smallholders	DAHD, ICAR-IGFRI, State Agriculture Departments
Extend equal opportunity for smaller dairy institutions including MPCs	Structural, policy — provide level playing field for wholly farmer-owned enterprises	Ministry of Cooperation, State AHDs, NDDB
Build a national dairy data platform and shared traceability standards	Long-horizon, structural — enables financing, MRV, and export market access	Large processors in partnership with DAHD and NDDB
Introduce mandatory compliance of BIS and FSSAI standards for cattle feed	Regulatory — eliminates poor quality feed and incidences of adulteration and creates a quality floor for the market	FSSAI, BIS, DAHD, CLFMA (Compound Livestock Feed Manufacturers Association)
Renew and expand the MNRE biogas subsidy scheme	Demand-side financing - restores the primary instrument for dairy biogas adoption at scale	MNRE, DAHD, NITI Aayog
Introduce sustainability-linked milk pricing premiums	Market-shaping - creates demand-side incentive for climate-smart practice adoption	Large dairy companies and processors

Action	Nature	Best-Placed Actor(s)
Mandate regular deworming and mineral supplementation (chelated Area-Specific Mineral Mixtures-ASMM) across procurement networks	Quick win — up to 20% yield gain at minimal cost	MPCs, cooperatives, private processors and state AHDs (Animal Husbandry Departments)
Develop village-level BIS-certified feed delivery partnerships	Quick win, replicable — modelled on proven MPC–feed manufacturer partnerships	MPCs, smaller dairies, feed manufacturers
Pilot parametric heat-stress livestock insurance & community micro-cooling infrastructure	Risk-mitigation protects the smallholder yields during severe thermal stress and dry seasons	DAHD, Insurance regulators (Insurance Regulatory and Development Authority of India - IRDAI), financial institutions
Commission state-level climate risk assessments for dairy geographies	Evidence-building — mainstreams climate into breed, infrastructure, and investment planning	DAHD, State AHDs, private processors
Mainstream climate criteria into dairy scheme design and monitoring	Cross-cutting, programmatic — embeds climate outcomes into scheme targets, indicators, and evaluation	DAHD, State governments, NDDB

6.1 | Strengthen Feed and Fodder Systems

- Develop a national fodder security strategy, bcked by regional fodder planning, strengthening certified fodder seed production and distribution chain, and establishment of fodder banks, that reflects agro-climatic diversity.
- Promote silage adoption at scale, building on Uttar Pradesh's mandatory-supply directive as a model for other states.
- Support Fodder Plus Farmers Producer Organisations (FPOs), fodder entrepreneurs and decentralised village-level input access, rather than relying solely on centralised infrastructure.
- Improve feed quality through enforceable BIS/FSSAI standards for cattle feed and key feed ingredients closing the adulteration and aflatoxin gap identified in Section 4.1 and Section 4.6.

6.2 | Improve Animal Health and Genetics

- Expand AI services and strengthen veterinary infrastructure, prioritising underserved and smallholder-dominant geographies. Also, integrate genomic selection for thermotolerance prioritising smallholder – dominant geographies.
- Improve preventive vaccination coverage and disease surveillance (digital), learning from the coordination gaps exposed by the 2023–24 Lumpy Skin Disease outbreak.
- Accelerate breed improvement toward climate-resilient indigenous and indigenous-dominant crossbred genetics (Sahiwal, Tharparkar, Murrah), consistent with the direction already visible across state programmes.
- Strengthen veterinary services through expanded sanctioned posts and para-veterinary training with appropriate clinical oversight, expanding Mobile Veterinary Units (MVUs), addressing the 20,000-post national vacancy identified in Section 4.3.

6.3 | Strengthen Extension and Capacity Building

- Invest in the extension workforce, prioritising sustained, repeated engagement models over one-off awareness campaigns.
- Promote digital advisory as a complement to, not a substitute for, trusted local extension, consistent with the finding in Box 2 (Section 4.2).
- Build farmer capacities through structured, repeated frameworks such as Gyan Dairy's 'Right Breeding, Right Feeding, Right Education' model, standardised into short practical modules for wider distribution.
- Encourage demonstration farms to make the economic case for climate-smart practice visible at the community level.

6.4 | Expand Access to Finance

- Expand dairy-specific credit products designed around dairy cash-flow patterns rather than standard fixed monthly instalments.
- Scale sustainability-linked finance and blended-finance mechanisms, building on NABARD's green-lending frameworks and climate taxonomy work.
- Build a stronger bank–dairy ecosystem by institutionalising Kisan Credit Card camps, dedicated dairy banking facilitation, and state-level bank partnerships. These mechanisms can enhance awareness, streamline credit delivery, and unlock the financing potential of schemes such as the Nand Baba Mission, enabling greater investment and sustainable growth across the dairy sector. Extend livestock insurance and credit guarantees to reduce the risk that currently deters smallholder investment in climate-smart infrastructure.

6.5 | Improve Markets and Value Chains

- Introduce sustainability-linked procurement and milk-quality incentives, giving climate-resilient practice a visible price signal for the first time.
- Strengthen producer aggregation through Producer Companies and FPOs to improve smallholder market access and bargaining position.
- Develop a credible national certification and traceability standard for indigenous dairy products, addressing the A2-labelling misuse identified during consultations and enabling genuine producers to capture a durable premium.

6.6 | Build Data and Digital Infrastructure

- Establish a national dairy data platform, sequenced to prioritise foundational farmer and animal/her management records first (Box 3, Section 4.7) before layering on more advanced traceability and reporting functions.
- Expand animal identification, building on and integrating with existing platforms such as Bharat Pashudhan.
- Strengthen farm level productivity monitoring, milk quality tracing and digital traceability across public/cooperative and corporate procurement networks.
- Develop emissions-reporting capability, learning from early exploratory work by Gyandhara and CavinKare, to support future climate-finance and export-market claims.

6.7 | Strengthen Institutions and Governance

- Improve convergence or establish an inter-ministerial coordination mechanism across ministries and departments — Animal Husbandry, Dairy Development, Banking, Agriculture, and Renewable Energy — to streamline multi-sectoral dairy investments and reduce the fragmentation identified as a systemic barrier in Section 4.8.
- Strengthen public-private partnerships, using the Sistema Bio–Katraj–NDDB–IKEA Foundation biogas model as a template for structuring similar collaborations in other domains.
- Support multi-stakeholder platforms such as the RDA as the standing mechanism for sustained, cross-sector coordination beyond individual consultation cycles.

Create a more enabling policy environment that allows Cooperatives, Milk Producer Companies, and private-sector actors to access relevant government support based on their role in delivering farmer and sector outcomes.

07.

Roadmap for Scaling Climate-Resilient Dairy Systems

Rather than presenting the recommendations in Section 6 as a flat list, this chapter sequences them into a phased roadmap, combining the sector-wide time horizons used throughout the CII-FACE consultations with the phased business logic set out in the companion RDA playbook, which similarly distinguishes immediate risk-reduction actions from the longer-term positioning that follows once foundational resilience is in place.



Horizon	
Short-term (1-2 years)	**Immediate priorities:** Expand AI coverage & mobile veterinary outreach; establish bank-facilitation mechanisms (KCC camps, dairy banking officers); Mass-roll-out deworming & mineral supplementation; sustain biogas demand-side subsidies. **Next priorities:** Pilot region-specific climate-risk assessments; scale silage adoption with smallholder financing support; mainstream women as primary extension and credit targets. **Enabling actions:** Activate dormant block-level coordination committees; Support companies in integrating climate resilient practices into their core business operations.
Medium-term (3-5 years)	**Immediate priorities:** Enforce mandatory compliance of BIS/FSSAI feed-quality standards and streamline multi-sectoral dairy investments; establish integrated single-window dairy service centres; build the national dairy data platform on/integrated with Bharat Pashudhan; scale blended finance and livestock/heat-stress insurance. **Next priorities:** Create level-playing opportunities for MPCs; implement the national fodder security strategy at scale; mainstream systematic climate-risk assessment into dairy-sector policymaking nationally. **Enabling actions:** Pilot sustainability-linked milk-pricing premiums; develop the national indigenous-dairy certification standard; establish dedicated climate-resilient-dairy skilling institutes; mainstream circular-economy frameworks linking biogas, organic fertiliser, and stray-cattle management, integrated with fertiliser-subsidy reform; embed sector-wide emissions reporting and export-ready quality standards.
Long-term (5+ years)	**System-building priorities:** Establish dedicated climate-resilient-dairy skilling institutes; Support companies and veterinary Universities in developing climate monitoring, reporting and verification tools; engage and build the capacity of youth as the next generation of dairy entrepreneurs, service providers and climate-resilient dairy practitioners. **Market and sector transformation:** Develop mutually beneficial partnerships between dairy farmers, consumers and dairy companies/cooperatives; strengthen farmer-processor partnerships to support resilient, climate-integrated dairy value chains across all major producing states.

08.
Conclusion



The evidence assembled in this paper, from three state consultations, Resilient Dairy Alliance discussions, and a National Consultation that tested these findings with senior government, industry, and financial-sector leadership, supports one central conclusion: India already possesses most of the technical solutions needed to build a climate-resilient dairy sector. Artificial insemination, balanced feeding, silage, biogas, digital advisory, and climate-resilient breeds are not missing technologies; they are, in various combinations, already operating successfully somewhere in the country.

The principal challenge, as the National Consultation put it plainly, is execution, not intent. Scaling these solutions from isolated pilots to sector-wide practice depends on stronger institutions that reduce fragmentation across departments; financing architecture that reaches smallholders and MPCs on terms suited to dairy cash flows; extension systems capable of sustaining behaviour change rather than one-off awareness; markets that reward, rather than are indifferent to, climate-resilient practice; and a policy environment that provides a consistent and enabling framework for cooperatives, MPCs, and private processors to contribute to climate-resilient dairy development according to their respective roles.The insights from the CII-FACE consultations and the Resilient Dairy Alliance demonstrate a genuinely broad consensus, across government, industry, cooperatives, MPCs, and financial institutions, on the direction of reform required. A coordinated, productivity-led approach, one that treats feed and fodder systems, farmer economics, and institutional convergence as the keystone priorities identified in this paper, can simultaneously improve farmer incomes, strengthen climate resilience, enhance nutritional security, and support the sustainable, export-ready growth of India's dairy sector that the National Consultation identified as the sector's next inflection point.

As the Resilient Dairy Alliance moves into its next phase of work, this paper is intended as a shared evidence base and a practical sequencing tool. The roadmap in Section 7 should be revisited as pilots mature, as new state consultations are added, and as the sectors priorities evolve based on the progress made (11)

09.
References

1. Jain, A., Tank, N., Bafna, A., Goyal, R., Jha, C., Manchanda, S., Srinivasan, M., Gupta, R., Haris, S., Agarwal, A., & Khandelwal, A. (2026). *Cattle and Community in a Changing Climate: Sustainable Pathways for India's Dairy Sector*. New Delhi: Council on Energy, Environment and Water (CEEW).
2. Choudhary, B. B., & Sirohi, S. (2022). Economic losses in dairy farms due to heat stress in sub-tropics: evidence from North Indian Plains. *Journal of Dairy Research*, 89(2), 141-147.
3. ICAR-National Dairy Research Institute (NDRI). (2023). Research findings on heat-stress impacts on fertility, milk production, and reproductive performance across cattle and buffalo breeds.
4. ICAR-Indian Grassland and Fodder Research Institute (IGFRI), Jhansi. Estimates of national green and dry fodder deficit.
5. Department of Animal Husbandry and Dairying, Government of India. (2024). *Basic Animal Husbandry Statistics 2024*.
6. Indian Dairy Association. Per-capita milk consumption trends and projections.
7. Rajeshwaran, S., Naik, G., & Dhas, A. C. (2014). Rising milk price — a cause for concern on food security. *IIM Bangalore Research Paper*, (472).
8. Raman Subramanian, R. S., Chandran Kakkagowder, C. K., Anbukkani Perumal, A. P., & Parthasarathi Gurusamy, P. G. (2019). Consumption, expenditure and demand analysis of milk and milk products in India.
9. Government of India Ministry of Fisheries, Animal Husbandry and Dairying Department of Animal Husbandry and Dairying
10. Department of Animal Husbandry and Dairying ADOPTION OF ADVANCE TECHNIQUE FOR MILK PRODUCTIVITY
11. ICAR (2026). Comprehensive Assessment of Feed and Fodder Resources for Increased Livestock Production in India.

NOTES

A global nonprofit with staff in over 30 countries, Environmental Defense Fund (EDF) creates transformational solutions to the most serious environmental problems. To do so, EDF links science, economics, and innovative private-sector partnerships to turn solutions into action.

EDF's approach to support an Indian pathway to shared, sustainable prosperity is well aligned with India's ambition. For more than a decade, EDF has supported India's low carbon development objectives by cultivating strategic partnerships, developing and implementing innovative solutions that address India's priorities. EDF works closely with the government (at national, state, and municipal levels) and Indian industry, academia and thinktanks.

EDF's work in India advances sustainable livelihoods for farmers and fishers, supports the Indian carbon market, drives industrial decarbonization, promotes sustainable business practices, and fosters science and innovation.

Confederation of Indian Industry

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering Industry, Government and civil society through advisory and consultative processes.

For more than 130 years, CII has been engaged in shaping India's development journey and works proactively on transforming Indian Industry's engagement in national development. With its extensive network across the country and the world, CII serves as a reference point for Indian industry and the international business community.

In the journey of India's economic resurgence, CII facilitates the multifaceted contributions of the Indian Industry, charting a path towards a prosperous and sustainable future. With this backdrop, CII has identified "Accelerating Competitiveness: Growth, Resilience, Inclusion, Sustainability, Trust" as its theme for 2026-27, prioritising five key pillars. During the year, CII will align its policy advocacy, institutional initiatives, partnerships, and outreach to support Indian industry in strengthening these five interconnected pillars of competitiveness.

Confederation of Indian Industry

The Mantosh Sondhi Centre
23, Institutional Area, Lodi Road, New Delhi – 110 003 (India)
T: 91 11 45771000 | E: info@cii.in • W: www.cii.in

Follow us on:

cii.in/facebook | cii.in/twitter | cii.in/linkedin | cii.in/youtube

Reach us via CII Membership Helpline Number: 1800-103-1244

FACE
CII-Jubilant Bhartia Food and Agriculture Centre of Excellence

FACE is CII's Centre of Excellence dedicated to building efficiencies across the agricultural value chain from farm to fork. FACE is charged with the mission of improving competitiveness of India' agriculture and food sector by catalyzing innovation, building capacity and enhancing productivity across the value chain. FACE works with farmers, companies, development institutions and the government to

- Improve on and off-farm productivity through the dissemination of best practices and technological innovation
- Invest in capacity building initiatives and skill development for supply chain participants across the value chain
- Strengthen linkages across the value chain through market access initiatives, thereby reducing losses and increasing farmer incomes

FACE's service portfolio comprises commodity specific value chain assessments and supply chain advisory services for food and agri businesses, training and consulting services in the area of food safety, and sectoral research across different market segments. FACE also works on projects in PPP mode, to develop business models that are scalable and replicable across geographies.

CII Food and Agriculture Centre of Excellence (FACE)
Confederation of Indian Industry

Andhra Association Building, 4th Floor
24-25 Institutional Area, Lodi Road, New Delhi-110003, India
T: +91 45771000 | E: face-info@cii.in | W: www.face-cii.in/