

Livestock & Feed Trends



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From the Chairman's Desk.....

Dear Friends,

Warm greetings to you all!

The period from April to June, 2026 has been marked by significant progress and meaningful engagement for CLFMA OF INDIA. Through active collaboration with Industry Stakeholders, Constructive Policy Advocacy and active participation in international initiatives, the Association, CLFMA OF INDIA has continued to strengthen its commitment to the growth and sustainable development of India's Livestock, Poultry, Aqua and Feed Sectors.

We sincerely appreciate your continued support and valuable contributions. Please find below a brief overview of **CLFMA's key activities for the period April to June, 2026**, presented under “**CLFMA Activity Updates**”:

During this quarter, CLFMA actively engaged with the Government of India on several critical policy matters, including the proposed National Animal Feed Act, Food-to-Feed initiatives, rationalization of import duties on feed additives, the soybean meal supply crisis, technical grade urea availability, and measures to strengthen the feed industry's long-term sustainability. We also continued to represent the industry's interests through timely policy representations and constructive dialogue with various Ministries and government departments.

During this quarter, CLFMA OF INDIA actively engaged with the Government of India on several critical policy matters, including the proposed National Animal Feed Act, Food to Feed initiatives, rationalization of Import duties on feed additives, the Soybean meal supply crisis, technical grade urea availability, and measures to strengthen the feed Industry's long-terms sustainability. As the parent association representing all segments of the livestock, poultry, aqua, and animal feed sectors, CLFMA OF INDIA continued to advocate for the industry's interests through timely policy representations and constructive engagement with various Ministries and Government Departments.

CLFMA OF INDIA strengthened its global outreach through interactions with the Australian High Commission, Canadian High Commission, and other international organizations, and **CLFMA OF INDIA's Office Bearers successfully concluded its U.S. learning tour from 18th to 29th June, 2026**, during which a delegation led by Chairman Mr. Divya Kumar Gulati, along with Dy. Chairmen Mr. Sumit Surekha, Mr. Naveen Pasupathy and Mr. Abhay Shah, Immediate Past Chairman Mr. Suresh Deora, Hon. Secretary Mr. Nissar F.



Mohammed, Treasurer Mr. R. Ramkutty, and East Zone President Mr. Sameer Chotai, gained valuable insights into global best practices across the animal agriculture and feed value chain. The programme commenced in New Orleans with visits to the Cargill Reserve Export Terminal, a Mississippi River logistics tour, and interactions with Russell Marine Group and Eurofins, providing exposure to global agri supply chains, grain movement, trade, logistics, inspection and quality assurance. In Iowa, the delegation interacted with the Secretary of Agriculture, Iowa, visited the Iowa Soybean Association, Mid-Co Commodities, and the Iowa State University Feed Mill and Grain Science Complex, where they explored modern feed manufacturing, grain handling systems, research-driven innovations, and participated in expert technical sessions on animal nutrition and feed technology. The learning tour concluded with visits to Insta-Pro International, the Cargill Crush Plant, and a commercial farm, offering first-hand understanding of advanced soy processing, oilseed processing, value-added protein solutions, and sustainable farming practices. Commenting on the visit, Mr. Divya Kumar Gulati, CLFMA Chairman said, “The U.S. learning tour provided valuable exposure to different aspects of the animal agriculture value chain. The interactions and site visits offered important insights into trade, logistics, grain movement, quality assurance, soy processing, oilseed processing and farming practices, while creating opportunities for knowledge sharing and industry engagement.” Overall, the programme strengthened industry knowledge, encouraged international collaboration, and



reinforced CLFMA of India's commitment to adopting global best practices for the continued growth and sustainability of India's animal agriculture and feed sector. **CLFMA's delegations USA Learning Tour provided valuable exposure to global best practices in animal agriculture.**

The Association also maintained an active presence at leading National and International Conferences, exhibitions, and technical forums, including VIV Select India 2026, the India Maize Summit, Seafood and Aquaculture Workshops, VIP's 3 National Symposium, and several Stakeholder Consultations, reinforcing CLFMA's leadership role in shaping the future of India's Animal Agriculture Sector.

These initiatives reflect our unwavering commitment to policy advocacy, knowledge sharing, international co-operation, and sustainable growth for the entire livestock value chain.

I sincerely thank all our members, industry partners, government agencies, and stakeholders for their continued support and active participation in CLFMA's initiatives. Your encouragement enables us to represent the industry's interests with greater strength and purpose.

I would also like to express my heartfelt gratitude to all our Sponsors, who have already confirmed their support for the 67th National Symposium, 2026. Your generous contribution is deeply appreciated. I warmly invite other members and industry partners also to come forward and support CLFMA's flagship annual event, enabling us to continue creating impactful platforms for knowledge exchange and industry advancement.

As we move forward, CLFMA OF INDIA remains committed to fostering innovation, strengthening partnerships, and promoting policies that will further enhance the contribution of the feed and livestock sectors to India's agricultural growth, rural prosperity, and economic development.

With warm regards,

For **CLFMA OF INDIA**,



Mr. Divya Kumar Gulati
Chairman





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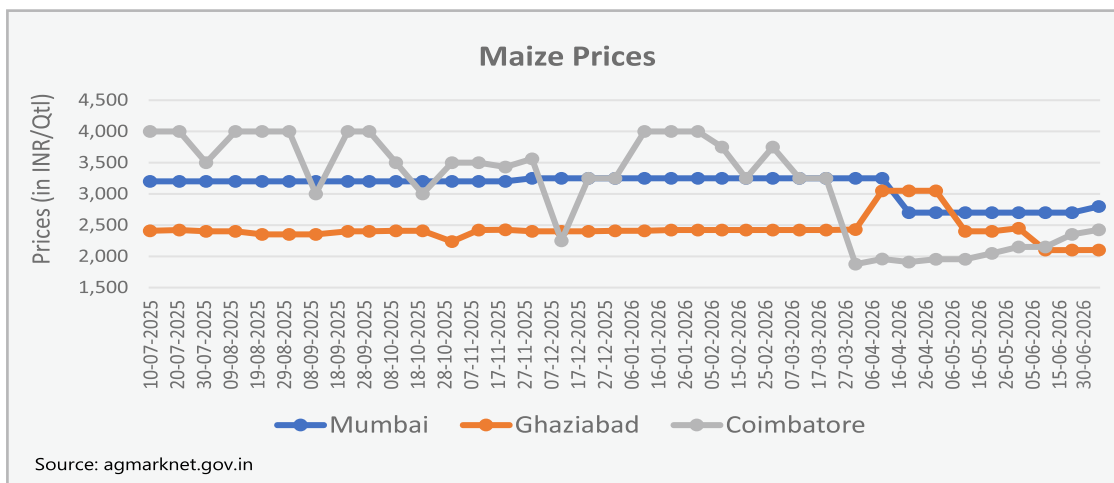
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Commodity Updates

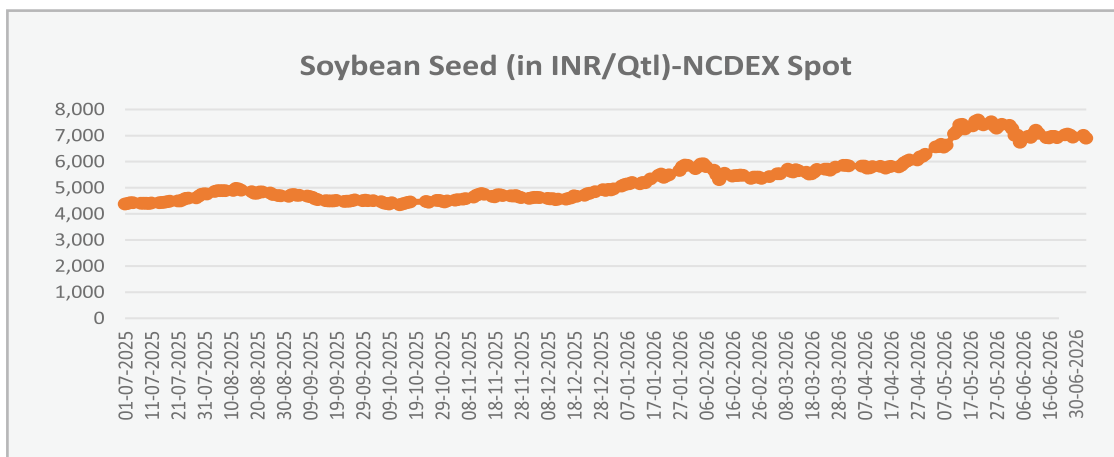
1. Domestic Prices

I. Maize



Maize Prices (INR/Quintal)		
City	30/06/2026	31/05/2026
Mumbai	2,800	2,700
Ghaziabad	2,103	2,450
Coimbatore	2,425	2,150

II. Soybean

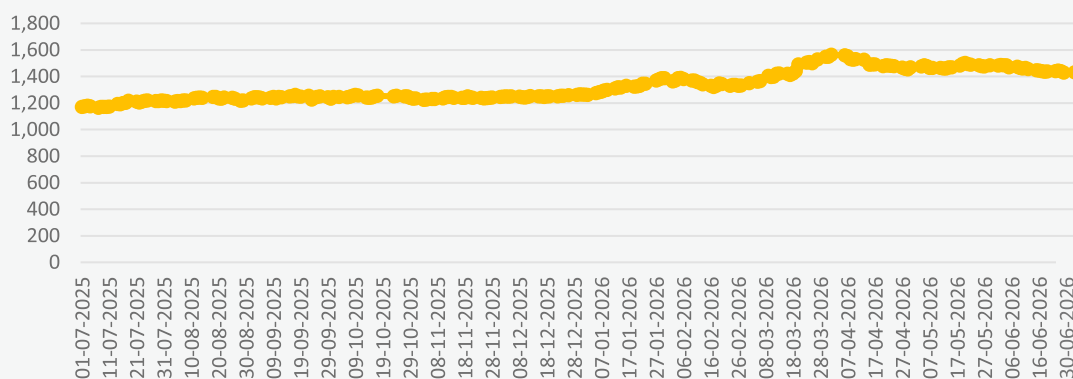


Soybean Complex Prices-NCDEX Spot

Commodity (Unit)	30/06/2026	31/05/2026
Soybean Seed (in INR/Qtl)	6,898	7,432
Ref. Soya Oil (in INR/10kg)	1,430	1,484
Soymeal (in INR/MT)	60,500	65,500

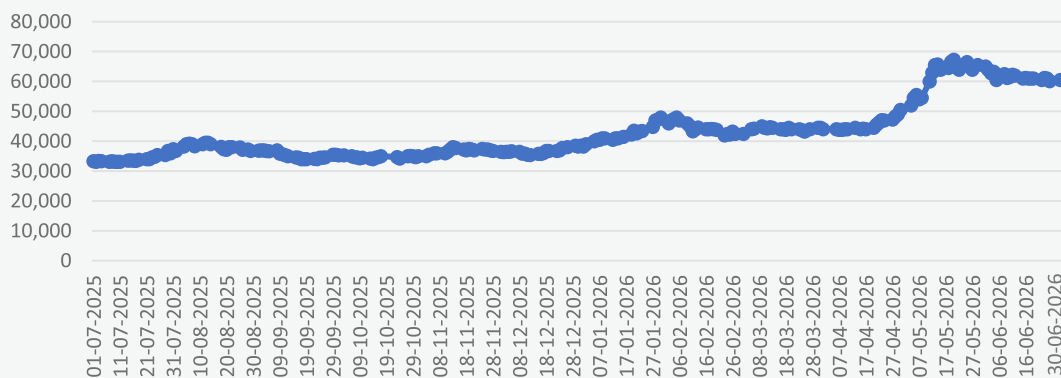
Ref Soya Oil

Ref. Soya Oil (in INR/10kg)-NCDEX Spot

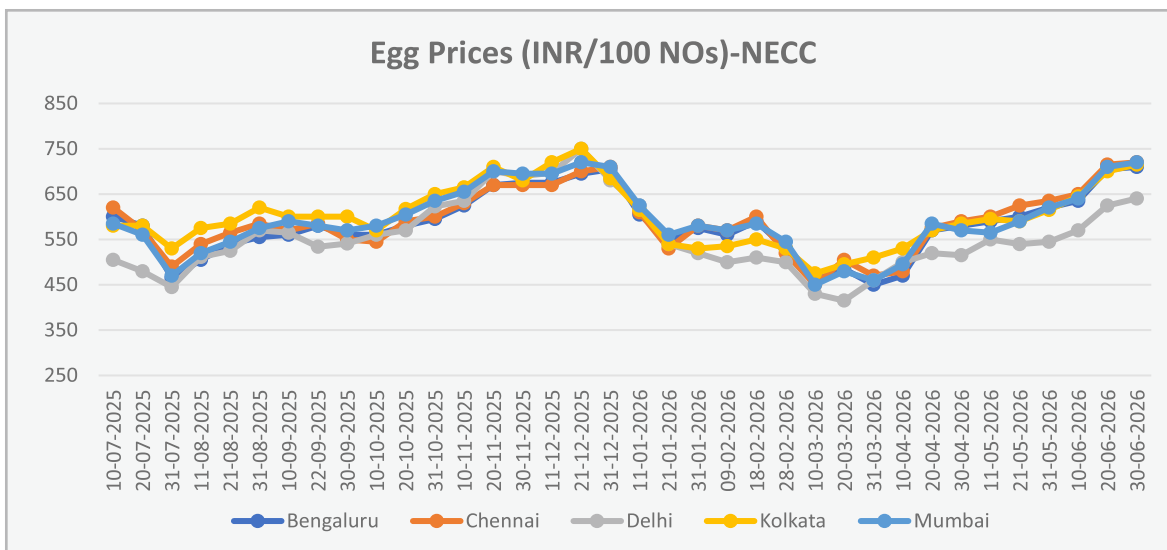


Soymeal

Soymeal (in INR/MT) -NCDEX Spot



III. Egg Rates



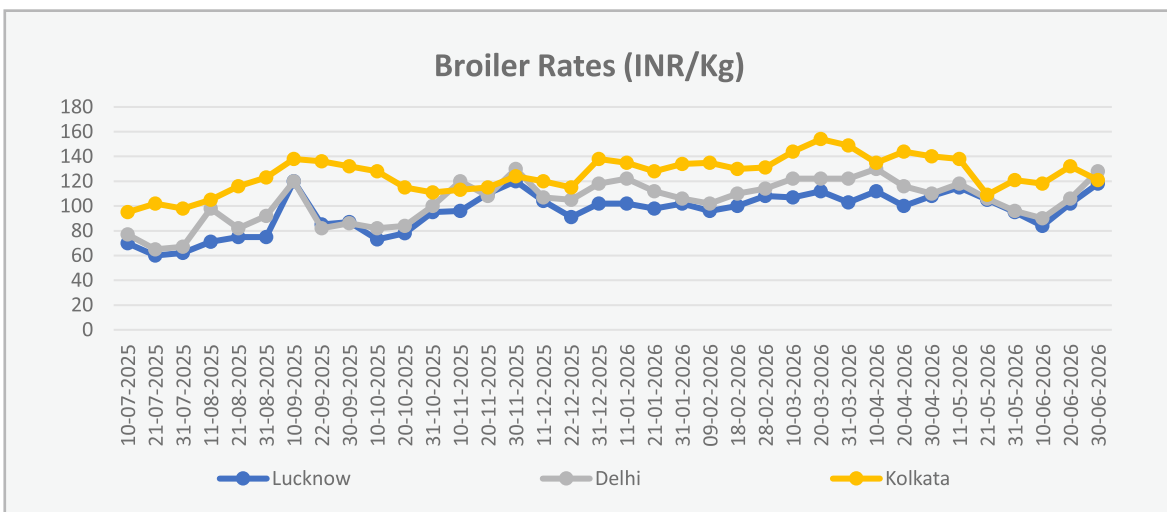
EGG PRICES (INR/100 NOs)		
Name of Zone	30/06/2026	31/05/2026
NECC Prices		
Ahmedabad	675	570
Ajmer	635	515
Barwala	614	518
Bengaluru (CC)	710	620
Brahmapur (OD)	665	565
Chennai (CC)	720	635
Chittoor	713	628
Delhi (CC)	640	545
E.Godavari	640	540
Hospet	650	560
Hyderabad	650	555
Jabalpur	660	555
Kolkata (WB)	715	615
Ludhiana	616	514
Mumbai (CC)	720	620
Mysuru	725	630
Namakkal	650	570
Pune	725	620
Raipur	650	550
Surat	700	590
Vijayawada	680	580
Vizag	640	540
W.Godavari	640	540
Warangal	652	557

III. Egg Rates

EGG PRICES (INR/100 NOs)		
Name of Zone	30/06/2026	31/05/2026
Prevailing Prices		
Allahabad (CC)	671	543
Bhopal	660	515
Indore (CC)	660	500
Kanpur (CC)	638	500
Lucknow (CC)	657	523
Muzaffarpur (CC)	675	555
Nagpur	700	540
Patna	675	555
Ranchi (CC)	676	571
Varanasi (CC)	667	540

Source: NECC

IV. Broiler Rates



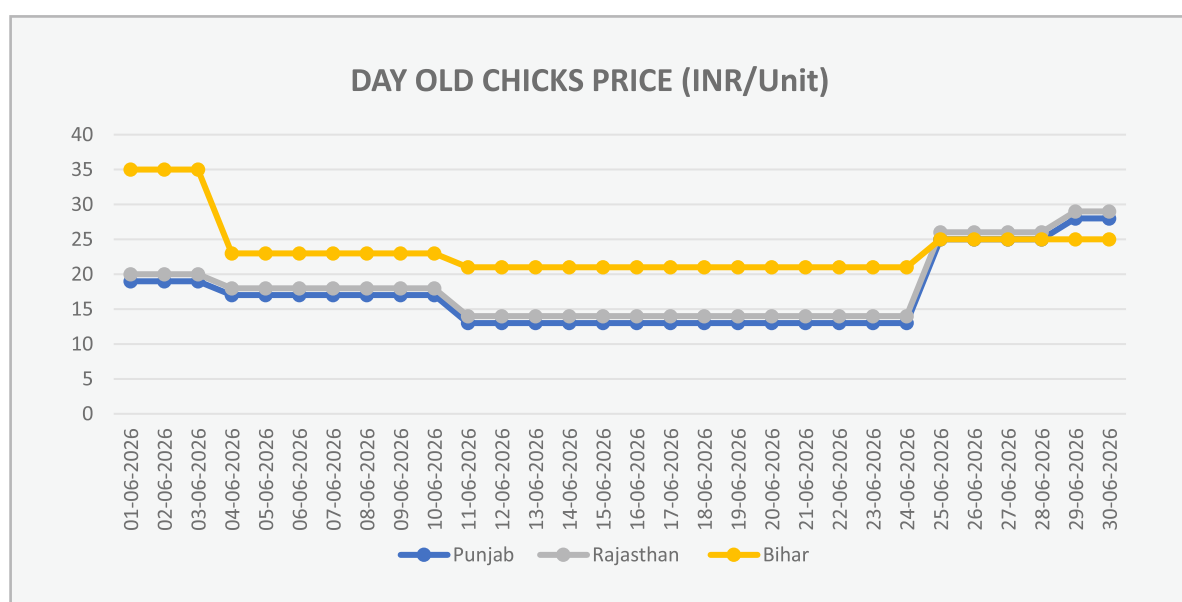
BROILER RATES (INR/Kg)		
Location	30/06/2026	31/05/2026
Delhi	128	96
Punjab	130	85
Raipur	105	92
Pune	134	118
Bengaluru	134	123
Hyderabad	145	128
Guwahati	128	112
Kolkata	121	121
Bihar	126	93
Madhya Pradesh	144	132
Lucknow	118	95

Source: SRP (Wholesale Rates)

V. Day old Chicks Price

DAY OLD CHICKS PRICE (INR/Unit)		
State	30/06/2026	31/05/2026
Punjab	28	19
Dehradun	28	23
Haryana	28	19
Himachal Pradesh	29	20
Rajasthan	29	20
Jammu	29	21
Andhra Pradesh	38	43
Uttar Pradesh	25	30
Madhya Pradesh	40	45
Telangana	38	43
Bihar	25	35
Jharkhand	26	35
Gujarat	40	45

Source: Poultry India TV/ SRP





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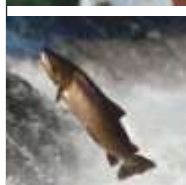
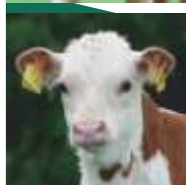
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VI. Fish Prices

Fish Prices Average Price (INR/Quintal)		
Fish Type	30/06/2026	31/05/2026
Bata Putti	8,800	8,200
Black Dom	14,000	15,000
Chilwa	11,000	11,500
Halwa	30,000	30,500
Hilsa	50,000	45,000
Katla (Small)	10,500	10,000
Malli (Big)	22,500	21,500
Malli (Small)	15,500	15,500
Pangass	8,500	7,500
Katla (Big)	12,500	19,500
Singhra (Big)	37,000	25,500
Singhra (Small)	15,500	15,500
Surmali (Small)	27,500	36,000
Surmai (Big)	40,500	45,500
Sol	40,000	34,500
Soli	15,000	15,500
Rahu (Andhra)	11,000	12,500
Zinga (Zambo-A)	45,000	49,500
Zinga (Zambo-B)	45,000	39,500
Zinga (Zambo-C)	30,000	31,000

Source: agmarknet.gov.in
The Prices are of Delhi (Gazipur Mandi)

2. Global Commodity Prices

Commodity (Unit)	PRICE (30/06/2026)
Milk (USD/CWT)	15.98
Rapeseed (Euro/Ton)	512.75
Soybean Meal (USD/Ton)	304.60
Soybean Oil (USD/lb)	0.69
Live Cattle (USD/Lbs)	2.57
Poultry (USD/Kgs)*	1.46
Eggs US (USD/Dozen)	0.25

Source: trading economics; markets.businessinsider

USD: United States Dollar

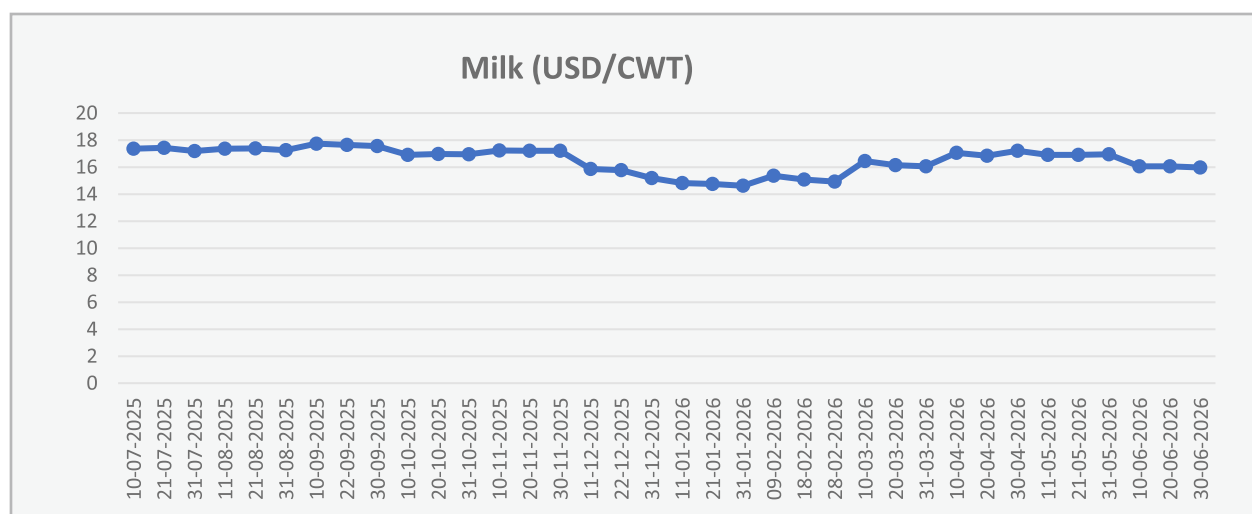
CWT: Short Hundredweight

Lbs: Pounds

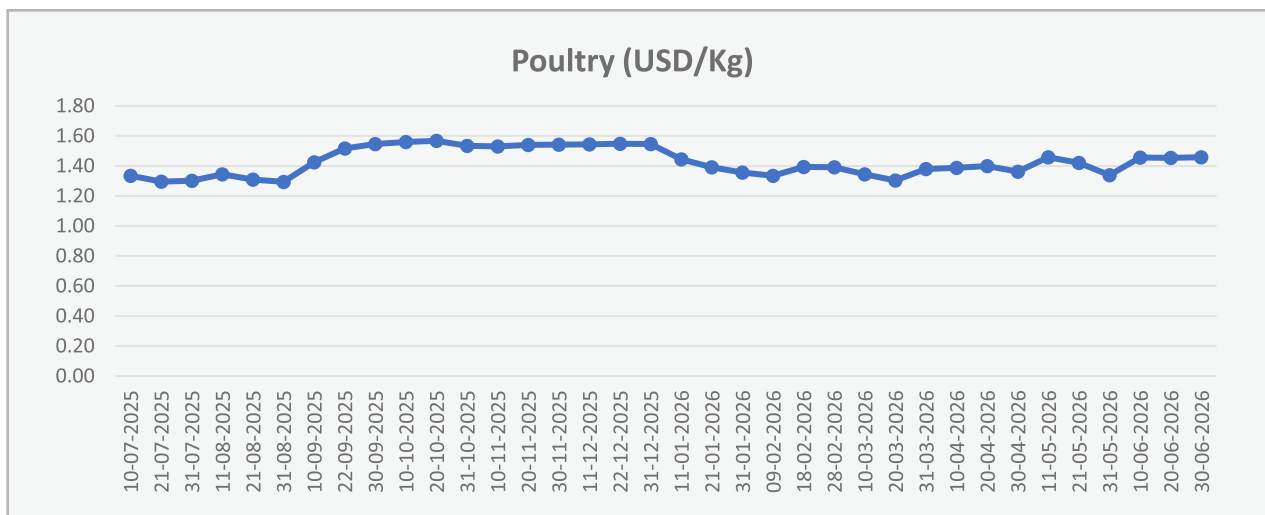
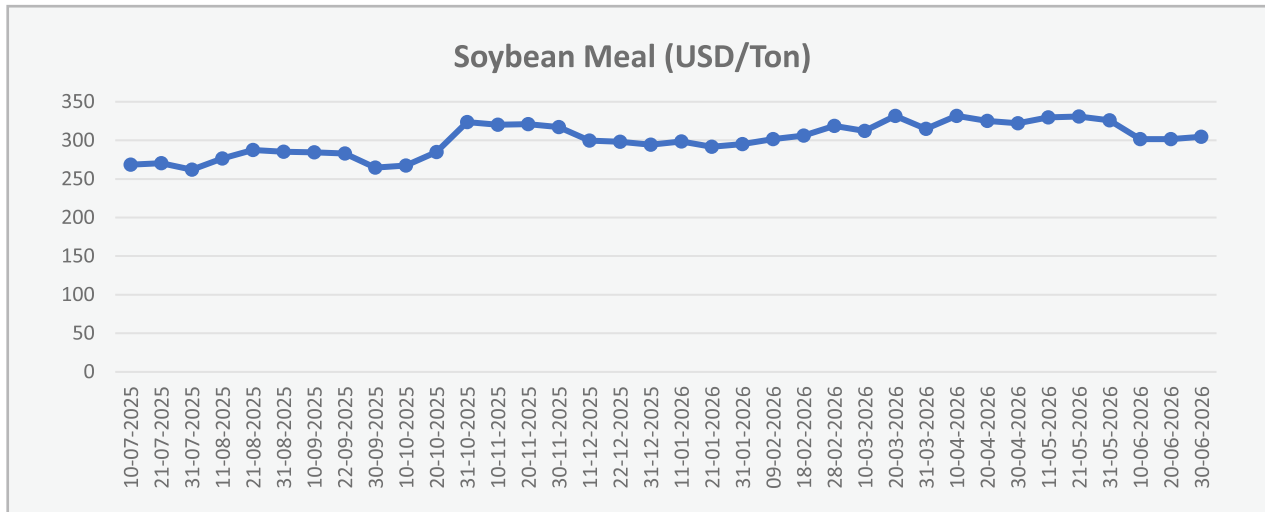
1 BRL (Brazilian Real) = 0.19 USD

*-Poultry price refers to the cost of the chicken in the wholesale market of São Paulo, Brazil. The price is converted from BRL to USD using above

*-Poultry price refers to the cost of the chicken in the wholesale market of São Paulo, Brazil. The price is converted from BRL to USD using above conversion rate.

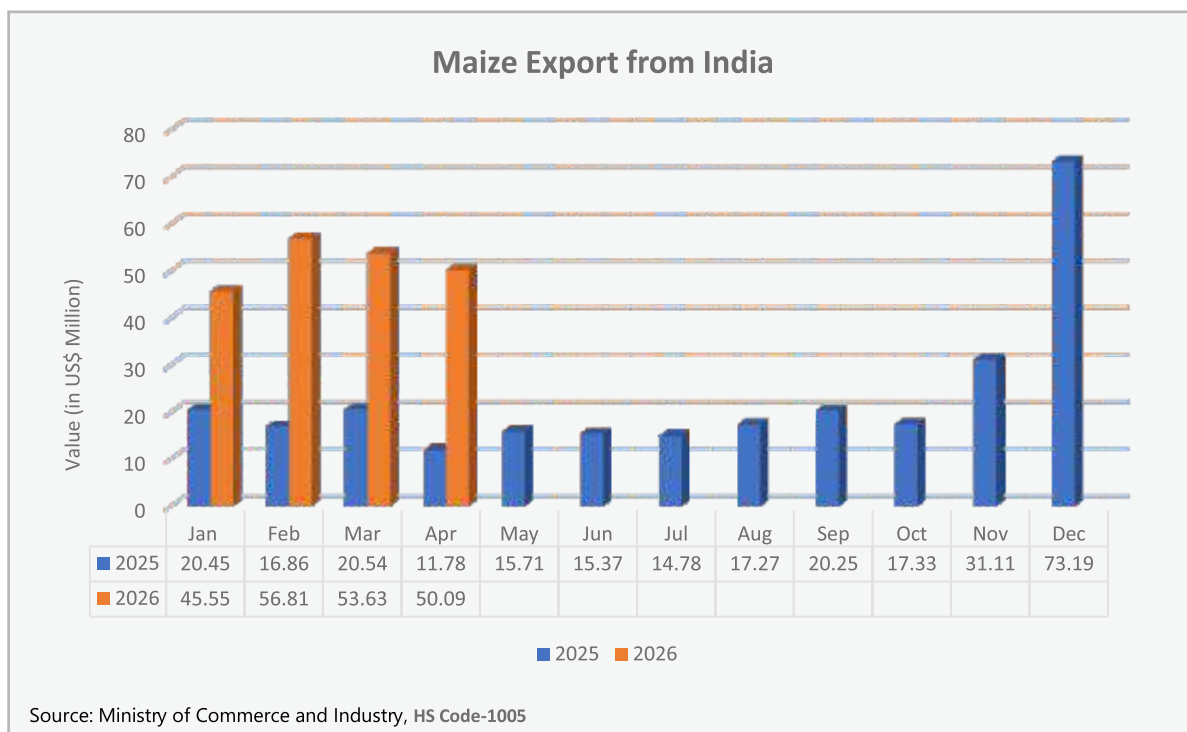


2. Global Commodity Prices



3. Trade Details

India: Maize Export

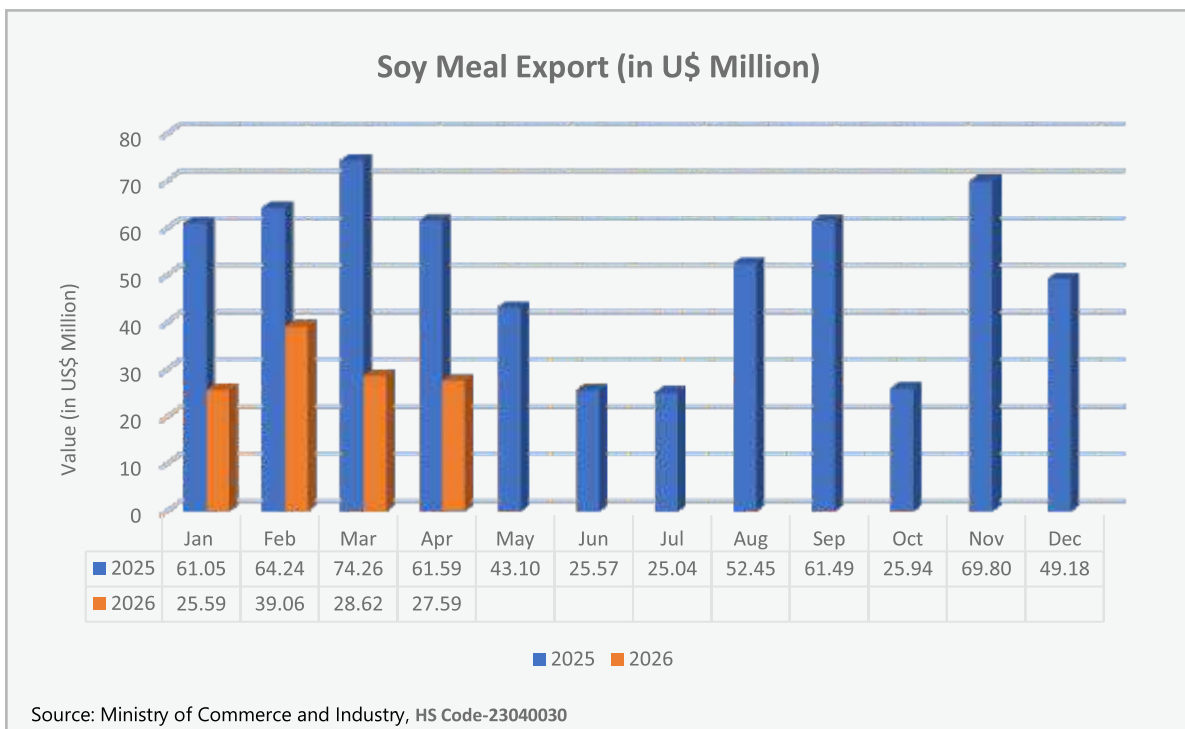


India: Maize Import

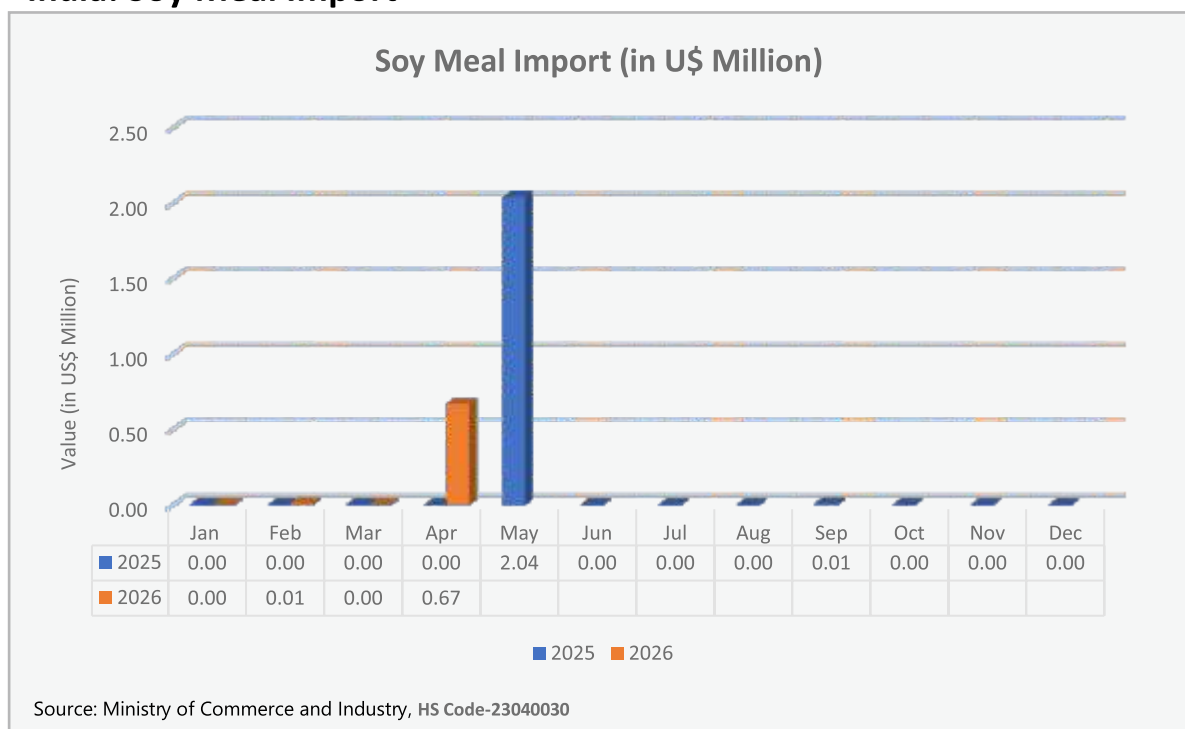


Note: This Data is sourced from the Ministry of Commerce and Industry, which was last updated in April.

India: Soy Meal Export



India: Soy Meal Import



Note: This Data is sourced from the Ministry of Commerce and Industry, which was last updated in April.

5. Market Drivers

Maize

Market Drivers	Monthly Outlook
Growing Demand for Poultry and Livestock Feed	Bullish
Rising demand for Ethanol in Auto-fuels	Bullish
Increasing Demand as a Wheat Substitute due to Wheat Export Ban	Bullish
Increasing Food Inflation	Bearish
Commercialization of Genetic Modified Maize Crop	Bullish
Increasing demand for Coarse Cereals	Bullish

Poultry

Market Drivers	Monthly Outlook
Rapid Growth in Consumer Demand for Livestock Products	Bullish
Rising Demand for White Feather Broilers	Bullish
Increasing Broiler Chicken Price Increases Due to Higher Feed Cost	Bearish
Increasing Food and Feed Inflation	Bearish
Enhancement of Backyard Poultry Farming	Bullish
Increasing the Demand of Organic Poultry Farming	Bullish

Regards,
CLFMA OF INDIA
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Sourced by: IMARC Group



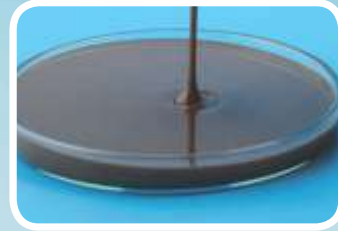
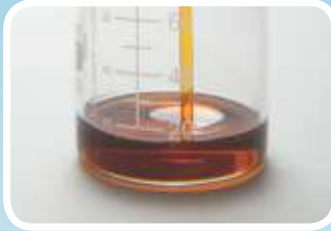
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CLFMA ACTIVITY UPDATES

CLFMA OF INDIA - Meeting with Government of India on 9th April 2026:

CLFMA OF INDIA had submitted a formal representation on 31st March 2026, advocating for the inclusion of Safe Food-to-Feed Pathways in the FSSAI Guidelines on Disposal of Food Waste. In response to this important submission, the Government of India scheduled a meeting on 9th April 2026 at 5:00 pm to deliberate on the matter.

Representing CLFMA OF INDIA at the meeting were Chairman Mr. Divya Kumar Gulati and Executive Director Col. Vinay Kumar. The discussion primarily focused on the concept of converting food waste into animal feed, highlighting its potential benefits in terms of sustainability, resource efficiency, and cost optimization for the livestock sector.

The meeting was attended by senior officials from the Government of India, including, Ms. Varsha Joshi, Additional Secretary, Department of Animal Husbandry and Dairying, GOI, Dr. Hans Raj Khanna, Joint Commissioner (NLM), Department of Animal Husbandry and Dairying, GOI, Dr. Ani Bency Jacob, Assistant Commissioner (NLM), Department of Animal Husbandry and Dairying, GOI, Ms. Puja Rustagi, Director (Trade/IC/Dairy), Department of Animal Husbandry and Dairying, GOI, Dr. Muthukumarasamy B., Joint Secretary (NLM/SD), Department of Animal Husbandry and Dairying, GOI. All officials are part of the Ministry of Animal Husbandry, Dairying and Fisheries, Government of India.

During the meeting, CLFMA OF INDIA presented key insights on the

advantages of the Food-to-Feed approach, emphasizing its role in reducing food waste, enhancing feed resource availability, and supporting environmental sustainability.

Following the interaction, the Government officials held an internal discussion to further evaluate the inputs and suggestions provided by CLFMA OF INDIA.

CLFMA of India - Participation in ICAR-IIMR Zoom Meeting on 9th April 2026:

ICAR - India Institute of Maize Research successfully conducted Session III on the topic "Road Map for Sustainable Maize Production in India" on 9th April, 2026, via zoom, bringing together experts from Research, Industry, and Policy Domains

The session focused on addressing key challenges and opportunities in India's Maize Sector, with emphasis on enhancing productivity, while ensuring environmental sustainability. Deliberations highlighted the need for adopting climate - resilient maize varieties, promoting efficient water and nutrient management practices, and strengthening extension services to improve farmer adoption of modern technologies.

Experts also stressed the importance of developing robust value chains, ensuring price stability, and fostering closer collaboration between stakeholders across the maize ecosystem. The growing demand for maize from the poultry, livestock, and industrial sectors was recognized as a significant driver for future growth.

From CLFMA OF INDIA, Col. Vinay Kumar, Executive Director, stressed the need for timely sowing during the Rabi and Kharif seasons to enhance maize productivity.

The session concluded with a consensus on adopting an integrated and forward-looking approach to ensure sustainable maize production in India, aligning with national goals of food security and agricultural resilience.

CLFMA of India - Participation in GOI Zoom Meeting on Dairy Exports on 10th April 2026 at 3:00 PM:

CLFMA has received email from Mr. Dayanand Appa Sawant, Deputy Commissioner (Dairy Development), Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, GOI. From CLFMA OF INDIA, Col. Vinay Kumar, Executive Director, and Dr. R. S. Masali, Member of the Technical Committee, attended the said meeting.

A representative from Amul highlighted the issue of containers being stuck at ports due to the ongoing conflict involving Iran, Israel, and the US. The Government took note of the situation and is expected to come up with a suitable solution.

CLFMA of India - Participation in Maize Survey Report Dissemination on 15th April 2026:

With reference to the contract with Satsure for the dissemination of the Maize Survey Report, CLFMA OF INDIA participated in a discussion meeting convened by Ms. Monika Madan of Satsure on 15th April 2026.

From CLFMA OF INDIA, Col. Vinay Kumar attended the meeting. Other participants included Mr. Naveen Pasupathy, President of Karnataka Poultry Farmers & Breeders Association (KPFBA); Mr. Reece H. Cannady, Regional Director (South Asia), and Mr. Amit Sachdev, Regional Consultant from the U.S. Grains & BioProducts Council.

CLFMA, along with other stakeholders is part of the contract with Satsure. Detailed discussions were held regarding the dissemination of the Maize Survey Report. It was observed that while data and information is being created but not being effectively disseminated to the Members.

All stakeholders, including USGBC, Satsure, CLFMA, and KPFBA, shared their ideas during the meeting. The need now is to identify and implement practical solutions.

It was proposed to constitute two Task Forces:

- A Governance Task Force
- An Execution Task Force

Each Task Force will comprise representatives from all stakeholder groups, with one representative from each organization, who would ensure appropriate execution of the ideas on ground for better outreach and dissemination of information.

CLFMA of India - Meeting with Australian High Commission on 17th April 2026:

CLFMA of India had the pleasure of hosting Mr. Adam Balcerak, Counsellor (Agriculture), Australian High Commission, New Delhi, along with Ms. Sweta Prabhakar, Senior Research Officer, and Ms. Swatika Malhotra, Research Officer from the Australian Government's Department of Agriculture, Fisheries and Forestry, on 17th April 2026 at 11:30 AM.

The meeting was attended on behalf of CLFMA of India by Chairman Mr. Divya Kumar Gulati, Immediate Past Chairman Mr. Suresh Deora, and Executive Director Col. Vinay Kumar.

The discussions centered on exploring bilateral trade opportunities and strengthening collaboration in the livestock sector, with a shared focus on fostering sustainable growth and innovation.



CLFMA OF INDIA - Meeting with Ms. Kim Baldwin at CLFMA Office on 20th April, 2026:

CLFMA Representatives:

Mr. Divya Kumar Gulati, Chairman, CLFMA OF INDIA

Mr. Suresh Deora, Immediate Past Chairman, CLFMA OF INDIA

Col. Vinay Kumar, Executive Director, CLFMA OF INDIA

Representatives from U.S. Grains & Bioproducts Council and United Sorghum Checkoff Program:

Ms. Kim Baldwin, Board Chairperson, United Sorghum Checkoff Program

Mr. Reece H. Cannady, Director, U.S. Grains & Bioproducts Council

Mr. Amit Sachdev, Consultant, U.S. Grains & Bioproducts Council

CLFMA OF INDIA had the privilege of hosting Ms. Kim Baldwin, Board Chairperson, United Sorghum Checkoff Program, for insightful discussions on the future of grains and the livestock sector, with a focus on strengthening bilateral trade opportunities.

The interaction was further enriched by the presence of Mr. Amit Sachdev, Consultant, U.S. Grains & Bioproducts Council, and Mr. Reece H. Cannady, Director, U.S. Grains & Bioproducts Council (formerly known as the U.S. Grains Council).

The discussions centered around the sorghum and grains business, highlighting how enhanced bilateral trade can significantly benefit the livestock sector, while also exploring avenues for further growth and collaboration in the future.

This engagement marks a progressive step towards fostering stronger partnerships between India and global stakeholders, reinforcing a shared commitment to the sustainable development and advancement of the livestock sector.



CLFMA of India - Participation in High-Level Committee Meeting on Draft "National Animal Feed Act" on 21st April 2026

CLFMA OF INDIA participated in the Meeting of the High-Level Committee constituted to draft the "National Animal Feed Act, 2026," held on 21st April, 2026 at 1:00 PM in hybrid mode at the Committee Room, 4th Floor, Chander Lok Building, New Delhi.

Representing CLFMA OF INDIA, Col. Vinay Kumar attended the meeting and contributed valuable inputs to the deliberations. He emphasized the need to establish a clear and defined timeline for the registration process under the proposed Act, ensuring efficiency and ease of implementation. He further highlighted that the direct involvement of FSSAI may not be necessary in this framework, and suggested that the Department of Animal Husbandry and Dairying should be entrusted with the primary responsibility for the governance, implementation, and assessment of the Animal Feed Act.

The meeting marked an important step towards shaping a structured and effective regulatory framework for the animal feed sector in India.

CLFMA of India - Participation in VIV Select India 2026 dated 22-24 April 2026:

CLFMA OF INDIA actively participated in the VIV Select India 2026 exhibition with a dedicated stall, which received an encouraging response from visitors across the three days. The stall witnessed strong engagement from industry stakeholders, reflecting the association's continued relevance and leadership in the livestock feed sector.

Key CLFMA representatives who visited the stall included Viz. Divya Kumar Gulati, Chairman, Suresh Deora, Immediate Past Chairman, Past Chairman Mr. C. Vasanthkumar, Dr. Dinesh Bhosale, Mr. S. V. Bhavé, Dr. A. S. Ranade, Chairman of CLFMA Technical Committee, CLFMA West Zone President, Dr. Saikat Saha, Mr. Anushrav Gulati, Member of CLFMA International

Liaison Committee, CLFMA North Zone President Dr. Devender Hooda, Dr. Vijay Makhija, Chairman of CLFMA Feed Additive and Customs Committee.

The CLFMA Secretariat team, led by Col. Vinay Kumar, along with Ms. Shilpa Utekar, Ms. Shraddha Kadam, and Mr. Dinesh Ambavkar, efficiently managed the stall and ensured smooth coordination throughout the event.

The successful debut of VIV Select India 2026 reflects strong industry demand for a dedicated, high-quality platform in India. With robust participation from domestic and international stakeholders, the event has laid a solid foundation for future editions and long-term growth.

VIV Select Asia extended their gratitude to exhibitors, visitors, speakers, industry associations, and government stakeholders whose contributions made the inaugural edition a meaningful and impactful success.





CLFMA Meeting with Canada's High Commission – 28th April 2026:

It was a pleasure to welcome Ms. Cendrine Hesson, Counsellor (Agriculture), High Commission of Canada to CLFMA of India.

The visit opened meaningful discussions on strengthening India - Canada collaboration in animal agriculture, livestock, and sustainable growth for the sector.

Here's to stronger partnerships and shared progress ahead.



CLFMA of India – Participation in 5th Regional Advisory Council (RAC) Meeting of Soy Excellence Center – India on 30th April 2026

The meeting brought together distinguished RAC members and sector leaders representing diverse domains including animal husbandry, feed milling, poultry, aquaculture, soy foods, nutrition, education, and leading

livestock associations. It served as a dynamic platform for meaningful dialogue, reflecting the strength of a well-aligned advisory forum.

Deliberations focused on reviewing progress, identifying priority areas, and strengthening strategic direction, while reinforcing India's position as a globally aligned platform for workforce development and enhanced industry impact on national growth.

CLFMA OF INDIA was well represented at the meeting by Mr. Divya Kumar Gulati, CLFMA Chairman, Dr. Saikat Saha, CLFMA West Zone President, Dr. A. S. Ranade, Chairman of the Technical Committee, Mr. Jaison John, Chairman of the International Liaison Committee, and Dr. Dinesh Bhosale, CLFMA Past Chairman. The CLFMA delegation marked its valuable presence and actively contributed to the discussions.



CLFMA representation to GOI on rationalization of import duty on Feed additives on 7th May, 2026.

CLFMA addressed a letter to Dr. Anil Bency Jacob, Assistant Commissioner (NLM), Department of AH&D, New Delhi dated 7th May, 2026 on the subject inputs from CLFMA OF INDIA on Rationalization of Import Duty on Feed Additives.

CLFMA representation to GOI dated 11th May, 2026

CLFMA wrote a letter to Shri. Rajiv Ranjan Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, GOI dated 11th May, 2026 on the subject urgent representation on sudden spurt in Soybean Meal Prices and Request for import of 1.5 MMT Soybean Meal with a cc copy to Shri. Piyush Goyal, Hon'ble Minister of Commerce and Industry, Department of Commerce, Ministry of Commerce and Industry, Government of India, New Delhi, Shri. Shivraj Singh Chouhan, Hon'ble Union Minister of Agriculture & Farmers' Welfare, Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, Mr. Naresh Pal Gangwar, The Secretary (AHD), Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi, Ms. Varsha Joshi, Additional Secretary (CDD), Department of Animal Husbandry and Dairying, Ministry of Animal Husbandry, Dairying and Fisheries, Government of India, Dr. Rajendra Prasad Road, New Delhi, Dr. Muthukumarasamy B., Joint Secretary (NLM / SD), Department of Animal Husbandry & Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi.

CLFMA OF INDIA at the 12th India Maize Summit 2026 on 15.05.2026

CLFMA OF INDIA Chairman Mr. Divya Kumar Gulati actively participated in

the **12th India Maize Summit**, held on 15th May 2026 at Federation of Indian Chambers of Commerce & Industry (FICCI), Federation House, New Delhi.

The summit brought together eminent industry leaders, policymakers, researchers, and stakeholders from across the agriculture and feed sectors to deliberate on the future of India's maize ecosystem. The discussions centered around enhancing productivity, sustainability, innovation, and resilience across the maize value chain.

The event featured insightful deliberations on key challenges and emerging opportunities, including climate change, demand forecasting, market accessibility, technological advancements, supply chain efficiency, and infrastructure development. Participants exchanged valuable perspectives and best practices aimed at strengthening India's maize sector and ensuring long-term food and feed security.

As India's feed industry continues to witness strong and sustained growth, one critical question echoed throughout the summit:

Where will the feed sector face its biggest challenge by 2030?

From ensuring raw material availability to building climate-resilient agricultural systems and encouraging innovation-driven growth, industry leaders — including the Chairman of CLFMA OF INDIA — emphasized the need for collaborative action and strategic planning to build a stronger, future-ready maize and feed ecosystem for India.

The Summit served as an important platform for meaningful dialogue, partnership, and collective vision-building, reinforcing the vital role of maize in supporting India's livestock, poultry, aqua, and food sectors while contributing to the nation's economic growth and sustainability goals.



CLFMA representation to GOI on Technical Grade Urea (TGU) dated 18th May, 2026:

CLFMA Wrote a letter to Dr. Praveen Kumar Singh, Agriculture Commissioner, Ministry of Agriculture and Farmers Welfare, New Delhi dated 18th May, 2026 on the subject Representation on the Shortage of Technical Grade Urea (TGU) and its impact on the Cattle Feed and Agri Supply Chains by referring our earlier letter addressed to Shri. Rajiv Ranjan Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying dated 8th April, 2026 with a cc copy to Shri.

Shivraj Singh Chouhan, Hon'ble Minister of Agriculture & Farmers Welfare, Dr. Praveen Kumar Singh, Agriculture Commissioner, Shri. Naresh Pal Gangwar, Secretary AHD, Shri. Rajat Kumar Misra, Secretary Dept. of Fertilizers, Ms. Varsha Joshi, Addl. Secretary (CDD/Trade/C), Shri. Sanjiv Singh, JS, DPIIT, Dr. Sujit K. Dutta, Joint Commissioner (NLM), regarding the urgent representation on the critical shortage of Technical Grade Urea (TGU) and its adverse impact on the dairy and cattle feed sectors.

CLFMA OF INDIA participated in the KPFBA Meet dated 20th May, 2026

CLFMA OF INDIA was represented at the KPFBA Meet on 20th May 2026, where Col. Vinay Kumar attended on behalf of Chairman Mr. Divya Kumar Gulati. The meeting provided an important platform for industry interaction and discussions on emerging opportunities and challenges in the feed sector.



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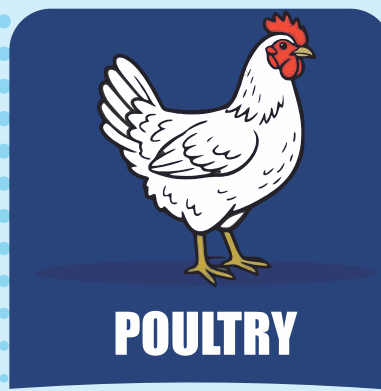
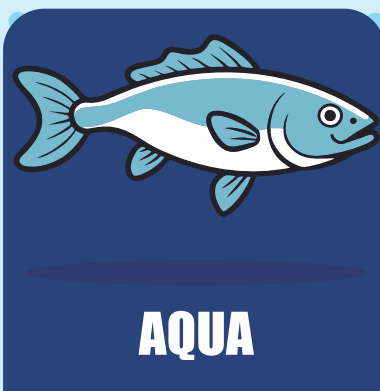
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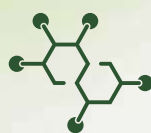
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CLFMA representation to GOI dated 25th May, 2026 to help one of our CLFMA Members:

CLFMA OF INDIA sent a letter to Shri. Anupam Prakash, JS (Customs), Central Board of Indirect Taxes and Customs (CBIC), New Delhi dated 25th May, 2026 on the subject Import of Mono Calcium Phosphate (Feed Grade) – 22.7% and 22% for Clearance under Chapter-23099090 to help one of our CLFMA Members.

CLFMA OF INDIA Participates in the Global Roundtable on Indian Marine Ingredients at Blue India 2026:

CLFMA OF INDIA actively participated in the Global Roundtable on Indian Marine Ingredients, organized as part of Blue India 2026, held from 4th to 6th June, 2026 at the Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, India.

The event was aligned with the Hon'ble Prime Minister's Vision 2030 for a Thriving Blue Economy in India, under the theme “**Blue Economy – Concept to Deployment**”, focusing on sustainable utilization of marine resources to support economic growth and environmental stewardship.

The Roundtable brought together eminent experts and industry leaders, including Dr. Mohamed Dawood Sait, President, Indian Marine Ingredients Association (IMIA); Dr. Vincenzo Zonno, University of Salento, Italy; Dr. Dung Le Viet, Vietnam National University of Agriculture (VNUA), Vietnam; Prof. (Dr.) A. Biju Kumar, Vice Chancellor, KUFOS, India; and Prof. (Dr.) Dinesh Kaippilly, Kerala University of Fisheries and Ocean Studies (KUFOS), India.

Mr. Nissar F. Mohammed, Hon. Secretary, CLFMA OF INDIA, participated in the Global Roundtable as a distinguished panelist and shared valuable insights on the sustainable utilization of fisheries by-products and marine waste management.

During the panel discussion, Mr. Nissar F. Mohammed emphasized the

immense potential of converting fisheries waste into valuable resources. He highlighted that fish waste can be effectively utilized for the production of fish soluble paste and a range of other value-added products, thereby reducing environmental impact and enhancing resource efficiency. He further noted that fish processing by-products are widely used in the manufacture of pelagic fish, supporting sustainable pelagic fisheries and contributing significantly to responsible and sustainable fishing practices.

CLFMA OF INDIA's participation in the Roundtable reaffirmed its commitment to promoting sustainable marine ingredient production, circular economy principles, and innovative solutions that support the growth of India's livestock, aquaculture, and fisheries sectors.



CLFMA OF INDIA Participated in the National Seafood Workshop held at Visakhapatnam on 5th-6th June, 2026:

CLFMA OF INDIA actively participated in the National Seafood Workshop held at Visakhapatnam, Andhra Pradesh, on 5th and 6th June 2026, which brought together policymakers, industry leaders, exporters, aquaculture experts, and stakeholders to deliberate on strategies for achieving India's

Vision 2047 Blue Economy goals.

Representing CLFMA OF INDIA, Mr. Nissar F. Mohammed, Hon. Secretary and other CLFMA Members participated in the discussions and shared valuable industry perspectives on the future of India's seafood and aquaculture sector.

Mr. Nissar F. Mohammed, Hon. Secretary, CLFMA OF INDIA requested Shri. Piyush Goyal, Hon'ble Minister of Commerce & Industry, Government of India to extend Government support for the disposal and management of fisheries waste. In response, Shri Piyush Goyal assured that the matter would be taken up and that a meeting would be convened to discuss and arrive at an appropriate course of action.

The workshop served as an important platform for discussing sustainable aquaculture development, export competitiveness, infrastructure enhancement, technological adoption, and policy reforms necessary for realizing the aspirations of the Blue Economy.

CLFMA OF INDIA expresses its sincere gratitude to Shri. N. Chandrababu Naidu, Hon'ble Chief Minister of Andhra Pradesh, Shri. Piyush Goyal Ji, Hon'ble Minister of Commerce & Industry, Government of India, Shri. Rajiv Ranjan Singh alias Lalan Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying and Min. of Panchayati Raj, Government of India and for their leadership, encouragement, and thoughtful consideration of industry recommendations. Their vision and commitment towards the growth of the seafood sector provide strong momentum for India's journey towards becoming a global leader in sustainable seafood production and exports.

CLFMA OF INDIA remains committed to working closely with government agencies, industry stakeholders, and policymakers to support the sustainable growth of India's aquaculture and seafood sectors and contribute meaningfully to the nation's Vision 2047 objectives.



CLFMA OF INDIA Actively Participated in VIP's 3rd National Symposium 2026 on "Future-Ready Poultry: Managing Risks, Maximizing Resilience".

CLFMA OF INDIA actively participated in the 3rd National Symposium organized by the Vets in Poultry (VIP) on 11th June 2026 in Bengaluru. The symposium, themed around building a resilient and future-ready poultry industry, brought together industry leaders, policymakers, researchers, veterinarians, nutritionists, and stakeholders from across the poultry value chain.

The event served as an important platform for discussing emerging challenges, technological advancements, sustainability initiatives, animal health, feed security, and strategies for strengthening the competitiveness of the Indian poultry sector. The insightful deliberations and expert presentations highlighted the need for innovation, collaboration, and proactive policy support to ensure long-term growth and resilience.

CLFMA OF INDIA's Chairman Mr. Divya Kumar Gulati, participation reaffirmed its commitment to supporting initiatives that promote sustainable development, knowledge sharing, and industry-wide collaboration. The Association appreciates the efforts of the organizers in bringing together key stakeholders to chart a roadmap for a stronger, more sustainable, and future-ready poultry industry in India.



Meeting with Department of Commerce Regarding Soybean Meal Crisis on 16th June, 2026:

Fruitful Discussion on the Soybean Meal Crisis Impacting India's Poultry & Livestock Sector:

With reference to the representations submitted by CLFMA OF INDIA and various Poultry Associations to Shri. Piyush Goyal Ji, Hon'ble Union Minister of Commerce & Industry, Government of India, regarding the ongoing soybean meal supply and price crisis, a meeting was held on 16th June 2026 at Vanija Bhawan, New Delhi, with senior officials of the Department of Commerce.

Representatives from leading industry bodies, including CLFMA OF INDIA, Poultry Federation of India (PFI), and Poultry Farmers and Breeders Association (PF&BA), Maharashtra met Mrs. Priya P. Nair, Economic Adviser (Joint Secretary Level), Department of Commerce, Ministry of Commerce & Industry, to discuss the serious implications of escalating soybean meal prices on the poultry and livestock sectors.

Key Issues Presented

The delegation highlighted the following concerns:

- Soybean Meal (SBM) is an essential protein source and a critical ingredient in feed formulations for poultry, dairy, aquaculture, shrimp, and other livestock sectors.
- India's poultry and livestock industries continue to register an annual growth rate of approximately 6–8%, contributing significantly to national food security, employment generation, and rural economic development.
- For FY 2026–27, the estimated national requirement of soybean meal is projected at 10.62 Million Metric Tonnes (MMT).
- Expected domestic soybean meal availability is estimated at only 8.32 MMT.
- This is likely to result in a supply deficit of approximately 1.74 MMT, leading to increased feed costs and putting substantial financial pressure on feed manufacturers, poultry farmers, dairy farmers, aquaculture producers, and consumers.

Industry Request

Considering the widening gap between demand and domestic availability, the industry delegation requested the Department of Commerce to place the matter before the Hon'ble Minister of Commerce & Industry and consider a time-bound import relief measure permitting the import of 1.5 MMT of Soybean Meal.

The proposed import window is expected to:

- Bridge the immediate supply deficit.
- Stabilize soybean meal prices in the domestic market.
- Reduce feed production costs.

- Support the sustainability and competitiveness of the poultry, dairy, aquaculture, and livestock sectors.
- Protect farmers, producers, and consumers from the adverse effects of excessive feed cost inflation.

Mrs. Priya P. Nair patiently heard the concerns raised by the delegation and provided valuable guidance on the matter. The delegation appreciated the constructive discussion and the positive engagement shown by the Department of Commerce.



OB's Visit to USA from 18 to 29 June 2026 mentioned in Press Release..... (Page Nos 39 to 42)

The Department of Animal Husbandry & Dairying (DAHD), Ministry of Fisheries, Animal Husbandry & Dairying, Government of India convened a virtual meeting on 22 June 2026 at 2:00 PM under the chairmanship of the Animal Husbandry Commissioner to deliberate on the introduction of vaccination against Highly Pathogenic Avian Influenza (HPAI) in India.

The meeting brought together key stakeholders from the poultry sector, including representatives from the Poultry Federation of India (PFI), CLFMA OF INDIA, Indian Federation of Animal Health Companies (INFAH), and other industry leaders.

During the discussion, the Animal Husbandry Commissioner, Dr. Naveen B Maheswarappa informed that vaccine manufacturers interested in importing HPAI vaccines may submit their applications to CDSCO for review. It was also noted that the Empowered Committee on Animal Health (ECAH) will examine the applications and guide the next steps in the approval process.

Industry representatives welcomed this development, describing it as a significant and long-awaited step toward strengthening disease control and safeguarding poultry production. They expressed appreciation to the Department for initiating structured discussions on HPAI vaccination, noting that several neighbouring and South Asian countries have already adopted vaccination strategies to manage the disease effectively.

Representatives from INFAH emphasized the need for formal communication and publication of advisory guidelines to ensure clarity and enable industry preparedness. They also appreciated the Department's proactive approach in considering vaccine access for farmers.

Speaking on behalf of the industry, representatives from PFI highlighted that the availability of HPAI vaccines through imports would provide substantial relief to the poultry sector. It was also suggested that this initiative could pave the way for future domestic manufacturing of HPAI vaccines in India, similar to existing production of Low Pathogenic Avian Influenza (LPAI) vaccines.

Overall, the meeting was seen as a positive step toward strengthening India's preparedness and response framework for avian influenza control through vaccination.

Mr. Ranpal Dhanda, President, PFI, Mr. Sanjeev Gupta, Dr. Vijay Makhija, Chairman-Biological and Biosecurity Sub-committee of INFAH, Dr. Deepak Kumar, Dr. Shirish Nigam, Dr. DK Dey, Col. Vinay Kumar, Executive Director of CLFMA OF INDIA and Mr. Ricky Thaper, actively participated in the said meeting.



CLFMA OF INDIA Participation in Maize Survey Project Data Rollout Planning Meeting dated 29th June, 2026:

Col. Vinay Kumar represented CLFMA OF INDIA at the Maize Survey Project Data Rollout Planning Meeting held on 29th June 2026 from 12:30 p.m. to 3:15 p.m. at Maple, India Habitat Centre, Lodhi Road, New Delhi.

The meeting featured a presentation by Satsure, led by Ms. Kavita Pandey, covering the sample report rollout, survey methodology, technologies and tools used for data collection, key deliverables, and an interactive discussion with the participating industry associations.

Representatives from PFI included Mr. Jagdish Kadyan, Manager, Mr. Ritvik, Manager and Mr. Sandhu (Secretary). KPFBA was represented by Mr. Sreejith, Manager and Mr. Vasanth Manickam, Executive Committee Member, while CLFMA OF INDIA was represented by Col. Vinay Kumar, Executive Director.

The discussion highlighted the robust data collection methodology and the

use of advanced technologies for maize acreage estimation and crop assessment. It was noted that the survey findings showed only minor variations when compared with Government estimates, demonstrating a high level of accuracy and reliability.

Participating associations suggested that the project dashboard should be updated regularly and that concise one-page reports be shared every ten days. It was also agreed that a virtual review meeting would be held within a week's time to discuss further improvements. Additionally, Satsure will undertake a roadshow and awareness campaign to familiarize stakeholders with the project and encourage wider adoption of the dashboard and survey outputs.



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CLFMA of India Delegation Concludes U.S. Learning Tour Focused on the Animal Agriculture Value Chain

- CLFMA of India delegation undertook a U.S. learning tour focused on the animal agriculture and feed value chain.
- The programme included visits to leading industry facilities and interactions with industry stakeholders across New Orleans and Iowa.
- The delegation gained insights into global agri supply chains, grain movement, quality assurance, soy processing, oilseed processing, and sustainable farming practices.

The Compound Livestock Feed Manufacturers Association (**CLFMA**) of India successfully concluded its **U.S. delegation visit**, bringing together industry representatives to gain insights into **global best practices across the animal agriculture and feed value chain**. The learning tour provided exposure to international approaches in **trade, logistics, grain movement, processing technologies, feed manufacturing, quality assurance and sustainable farming** through a series of industry interactions, academic engagements and site visits.

The delegation comprised:

- **Divya Kumar Gulati** – Chairman, CLFMA of India
- **Sumit Surekha** – Deputy Chairman
- **Naveen Pasuparthi** – Deputy Chairman
- **Abhay Shah** – Deputy Chairman
- **Suresh Deora** – Immediate Past Chairman
- **Nissar F. Mohammed** – Honorary Secretary
- **R. Ramkutti** – Treasurer
- **Sameer Chotai** – President – East Zone

The programme commenced in **New Orleans**, where the delegation visited the **Cargill Reserve Export Terminal** to gain exposure to trade, logistics and global agri supply chains. A **Mississippi River tour**, along with interactions with **Russell Marine Group and Eurofins**, provided insights into the systems supporting **international grain movement, inspection and quality assurance**.

The delegation then travelled to **Iowa**, where members interacted with the **Secretary of Agriculture, Iowa**, reinforcing CLFMA of India's focus on global dialogue and strengthening collaboration across the animal agriculture value chain

through **industry and policy-level exchanges**.

The Iowa programme also included a visit to the **Iowa Soybean Association Office**, where delegates participated in sessions featuring introductions, insights into **Iowa Soy**, and discussions with **Mid-Co Commodities**. The sessions facilitated knowledge sharing, collaboration and stronger industry connections.

As part of the Iowa programme, the delegation also visited the Iowa State University Feed Mill and Grain Science Complex, where members gained first-hand exposure to modern feed manufacturing processes, grain handling systems and research-led innovations supporting the feed industry. On the final day of the learning tour, delegates attended expert lectures and technical sessions, further strengthening their understanding of advancements in animal nutrition, feed technology and global industry best practices.

The learning tour concluded with visits to **Insta-Pro International**, where delegates explored advanced soy processing technologies and value-added protein solutions, and the **Cargill Crush Plant**, which provided

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insights into large-scale oilseed processing and its role in supporting the feed industry. The programme also included a **farm visit**, where delegates witnessed farming practices, management and sustainable production at the ground level.

Commenting on the visit, **Divya Kumar Gulati, Chairman, CLFMA of India**, said, "The U.S. learning tour provided valuable exposure to

different aspects of the animal agriculture value chain. The interactions and site visits offered important insights into trade, logistics, grain movement, quality assurance, soy processing, oilseed processing and farming practices, while creating opportunities for knowledge sharing and industry engagement."

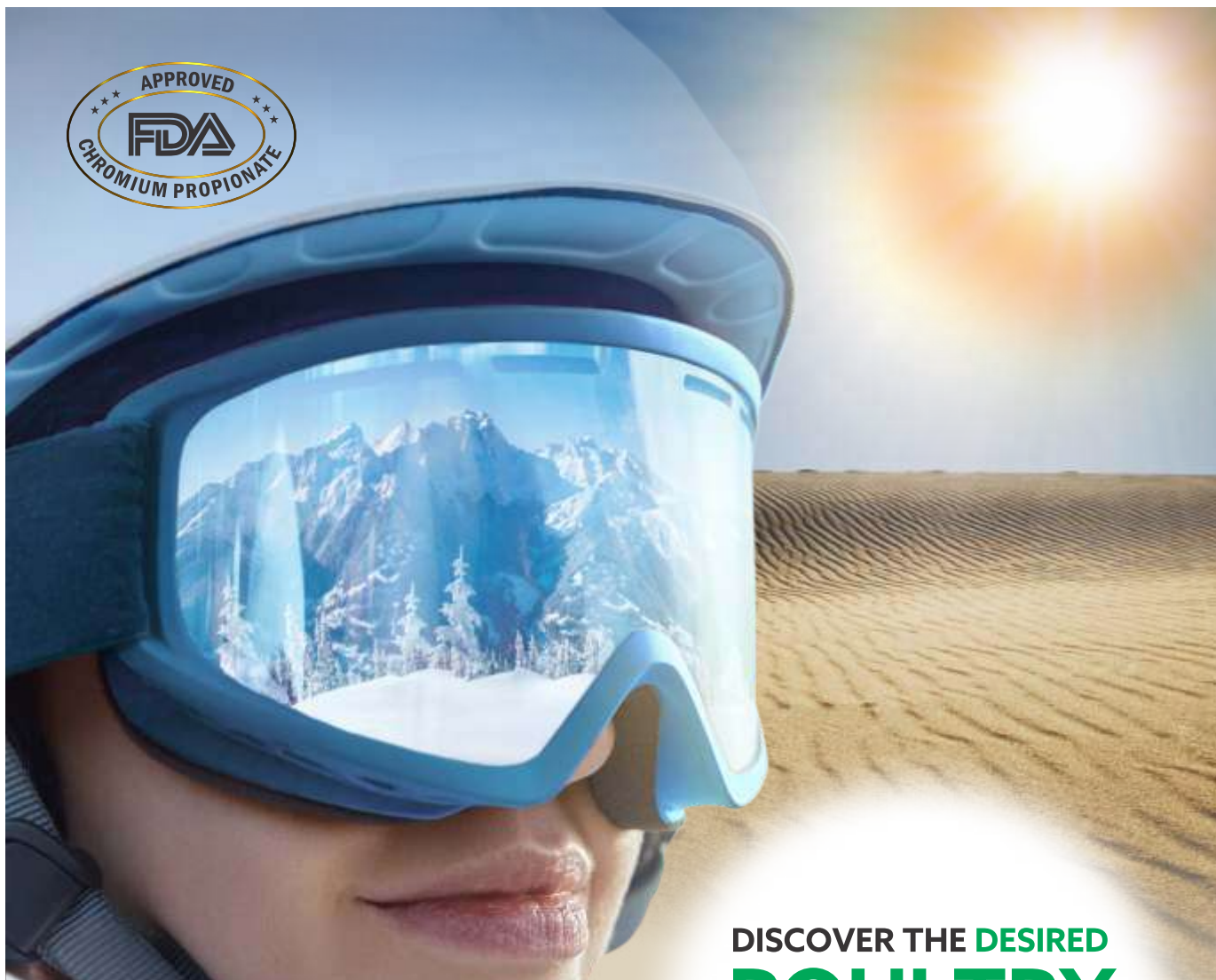
The learning tour highlighted

different aspects of the **global animal agriculture ecosystem**, providing exposure to practices across supply chains, processing, quality assurance and on-farm production. Through interactions with industry stakeholders and visits to key facilities, the programme supported continued knowledge exchange across the **animal agriculture and feed value chain**.









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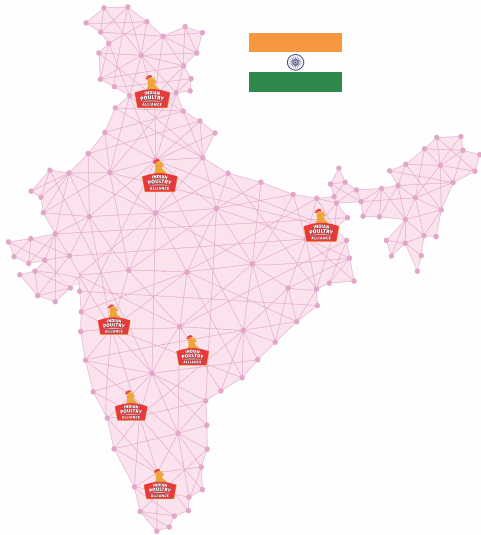
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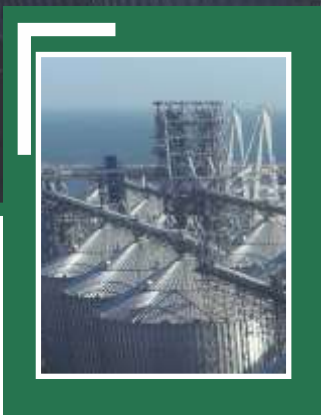
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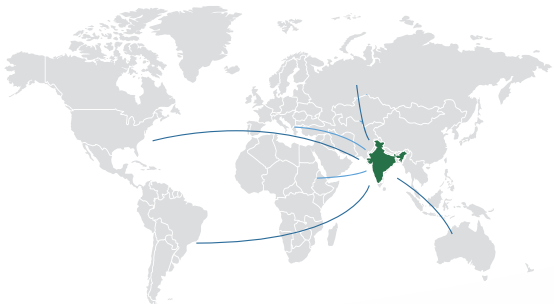


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India's marine fish landings post 3% rise in 2025 at 35.7 lakh tonnes

India's marine fish production rose a modest 3 per cent in 2025 to 35.7 lakh tonnes, according to the ICAR-Central Marine Fisheries Research Institute (CMFRI). Tamil Nadu climbed to the top spot with 6.85 lakh tonnes, overtaking Gujarat, which slipped to second after a 15 per cent drop amid adverse weather, extended fishing bans and cyclonic disruptions. Kerala retained third position, posting a marginal 2 per cent increase in landings. The value of marine fish landings rose strongly, touching ₹69,254 crore at landing centres (up 10.45 per cent) and ₹97,702 crore at the retail level (up 8.43 per cent), signalling firm demand. CMFRI data showed Indian mackerel remained the top species at 2.70 lakh tonnes, followed by cephalopods (2.57 lakh tonnes) and oil sardine (2.53 lakh tonnes). Cephalopods and threadfin breams recorded robust growth of 25 per cent and 55 per cent respectively, both hitting decadal highs. Pelagic fish dominated the catch with a 54 per cent share, followed by demersal resources, crustaceans and molluscs. Among key States, Karnataka recorded a sharp 44 per cent rebound after a weak 2024, while Maharashtra posted an 18 per cent increase. A standout trend in Kerala was the resurgence of Indian oil sardine, which emerged as the top species with 1.68 lakh tonnes, up 13 per cent and at a decadal high. However, heavy rains and a cargo shipwreck curtailed fishing activity in

May and June in the State's southern districts. "Favourable environmental conditions, along with regulated fishing pressure, enabled the recovery of small pelagic stocks," said Grinson George.

India's cold-water fisheries emerge as key pillar of blue economy, with J&K leading production growth

India's cold-water fisheries sector is becoming a crucial part of the Blue Economy, with Jammu and Kashmir leading the way, followed by Himachal Pradesh and Uttarakhand. The North Eastern states have also emerged as significant contributors. The central government has allocated over 25% of the total funds under the flagship scheme Pradhan Mantri Matsya Sampada Yojana (PMMSY) specifically for the development of cold-water fisheries. Cold-water fisheries are practiced in high-altitude, snow-fed rivers, streams, lakes, and reservoirs with temperatures ranging from 5°C to 25°C, dissolved oxygen levels above 6 mg/L, and pH levels between 6.5 and 8.0. This sector thrives in regions such as Jammu & Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Arunachal

Pradesh, Sikkim, Meghalaya, and Nagaland, as well as in the hill districts of West Bengal, Kerala, Karnataka, and Tamil Nadu. Together, these ecosystems span more than 533,000 square kilometers of mountainous terrain. India has identified over 278 cold-water fish species, highlighting the sector's importance for biodiversity conservation and sustainable mountain development. Although cold-water fish account for only 3% of India's total fish production, they are emerging as a major pillar of the Blue Economy by supporting the livelihoods and nutritional needs of millions living in challenging environments while promoting sustainable mountain development. India's total fish production reached 1,977,500 metric tonnes in 2024-25, marking a 106% increase since 2013-14. Inland fishing comprises around 150,000 metric tonnes of this total. Currently, cold-water fish production is approximately 7,000 metric tonnes, with trout production alone increasing nearly 1.8 times over the past decade to about 6,000 metric tonnes in 2024-25. Species such as rainbow trout, golden mahseer, and snow trout are cultivated using specialized infrastructure, including hatcheries, raceways, recirculating aquaculture systems (RAS), biofloc systems, and cold chain facilities. Trout farming is generally practiced at elevations above 1,500 meters, while mahseer culture is suitable at relatively lower altitudes. Jammu & Kashmir stands out as India's leading trout-producing region, yielding around 3,010 metric tonnes, followed by Himachal Pradesh with approximately 1,673 metric tonnes, and Uttarakhand with about 710 metric tonnes of trout production.

India's seafood exports grew from Rs 62k crore to Rs 68k crore this year: Fisheries Minister

India's seafood exports have crossed a new milestone, growing from Rs 62,000 crore last year to Rs 68,000 crore this year, reflecting a net increase of about Rs 6,000 crore, Union Minister Rajiv Ranjan Singh said on April 11. Speaking during the Seafood Exporters Meet 2026 in New Delhi, the fisheries minister appreciated and congratulated exporters for their efforts in enhancing seafood exports. "Despite global uncertainties, India's seafood exports have recorded robust growth, driven largely by strong performance in non-US markets. There is a huge export potential of high-value species such as tuna from the Andaman and Nicobar Islands, the EEZ and the high seas," the minister said. "There is also the need for improved onboard handling, robust cold-chain infrastructure, better packaging, value addition and the exploration of alternative markets to reduce post-harvest losses and strengthen the export ecosystem," he added. Exporters were urged to work towards achieving the Rs 1 lakh crore export target and adopt an open-market approach. Singh referred to the investors' meet held in the Andaman and Nicobar Islands, which has led to investments aimed at strengthening the fisheries sector, particularly in areas such as sea-cage culture, pearl farming and deep-sea fishing vessels. India's

seafood exports have recorded strong and sustained growth, expanding at an average annual rate of 7% over the past 11 years. Marine product exports have more than doubled during the period, rising from Rs 30,213 crore in 2013-14 to Rs 62,408 crore in 2024-25, driven largely by shrimp exports valued at Rs 43,334 crore, the ministry said in a statement. India's seafood exports span a wide and diversified basket, with over 350 varieties of products shipped to nearly 130 global markets. The United States remains the largest destination, accounting for 36.42% of total export value in 2024-25, followed by China, the European Union, Southeast Asia, Japan and the Middle East, while other markets together account for about 9%.

India targets near fourfold jump in fisheries exports to \$30 billion in 5 years

Commerce and industry minister Piyush Goyal on June 05 set an ambitious target of taking India's fisheries exports to more than \$30 billion over the next five years, from \$8.45 billion currently, and urged the industry to focus on value addition, branding and sustainable fishing practices. Addressing the National Workshop on Seafood Exports in Visakhapatnam, Goyal said India's fisheries exports have risen by about 70% since 2013-14, significantly outpacing global trade growth in the sector. He noted that seafood exports rose from around \$5 billion in 2013-14 to about \$8.5 billion in FY26, while

global fisheries trade increased from \$150 billion to \$164 billion during the same period. Stating that India has the potential to become a global leader in the sector, the minister stressed the need for responsible and regulated fishing. Responding to concerns over declining fish stocks, he said regeneration of small fish must be ensured to prevent environmental degradation. He added that no allegation of illegal fishing has been levelled against India's sustainable fishing practices. "Take India's fish across the world. Reduce import of raw shrimp and export value-added goods and build brands," he said. The workshop was attended by Andhra Pradesh chief minister N. Chandrababu Naidu, Union fisheries, animal husbandry and dairying minister Rajiv Ranjan Singh, food processing industries minister Chirag Paswan, civil aviation minister Kinjarapu Rammohan Naidu and representatives from the seafood industry. The Department of Fisheries is exploring a dedicated production-linked incentive (PLI) scheme for micro, small, and medium enterprises (MSMEs) in the seafood sector to enhance global competitiveness, strengthen export infrastructure, encourage technology adoption, support research and development, and promote value addition. Officials said approval by the European Union for exports from more than 125 Indian fisheries establishments during the last financial year helped offset losses faced by the sector due to US tariff measures. Speaking at the event, Rajiv Ranjan Singh said India must increase its share in global fisheries exports and emphasised greater value addition to improve returns for exporters and small fishermen.

Odisha targets top-five spot in egg production by 2047, unveils major livestock and fisheries initiatives

Odisha has set an ambitious goal to become the fifth-largest egg producing state in the country by 2047, as part of its broader vision to achieve self-reliance in milk, egg, and meat production. Chief Minister Mohan Charan Majhi announced this while addressing a state-level function marking World Veterinary Day on April 25th, 2026. Emphasizing the importance of a holistic development model, the Chief Minister underscored the need to strengthen the “One Health” approach, which integrates animal health, food safety, and public health. In a major push to enhance animal healthcare infrastructure, Majhi inaugurated 76 newly constructed veterinary hospitals and four animal help centres across the state, built at a cost of around Rs.100 crore. Additionally, Memoranda of Understanding (MoUs) were signed with six public sector undertakings (PSUs) for the establishment of 219 new veterinary hospitals and diagnostic laboratories, involving an investment of ₹177 crore. As part of these initiatives, a state-level molecular laboratory will be set up at Phulna khara in Cuttack with an estimated cost of Rs.10 crore. The government will also strengthen the state level feed testing laboratory with an outlay of

Rs.6 crore to ensure the quality of animal feed. Marking the 50th anniversary of OPOLFED, the Chief Minister launched dedicated marketing centres for brown eggs and indigenous ‘Aseel’ chicken, aiming to secure fair prices for poultry farmers. In the fisheries sector, a fish landing centre at Kasia in Bhadrak and the upgraded fishing harbour at Dhamra were inaugurated at a combined cost of Rs.50 crore, benefiting the fishing community. Highlighting the need to diversify income sources for farmers, Majhi stressed that allied sectors such as fisheries, dairy farming, poultry, and small ruminant rearing must be promoted alongside traditional agriculture. He noted that the government’s focus is not just to double farmers’ income, but to multiply it.

West Asia crisis cracks India’s egg export market as Gulf shipments fall sharply

India’s egg export market is beginning to feel the impact of the conflict in West Asia, with shipments to key Gulf destinations slowing sharply as freight costs rise and trade routes face disruption. Exports of India’s poultry products declined nearly 20 percent in March, according to trade data. Shipments to the United Arab Emirates fell 19 percent year-on-year, while exports to Oman collapsed by almost 90 percent. The decline is significant because the Gulf region remains the

dominant market for India’s egg exports, particularly for producers based in Tamil Nadu. In FY26, more than 82 percent of India’s egg exports were destined for Gulf countries. The UAE alone accounted for \$115 million of exports, while Oman imported \$26.8 million worth of Indian poultry products. Tamil Nadu’s Namakkal poultry belt, which anchors a large share of India’s egg exports, has been particularly affected. Most exports from the region are routed through VO Chidambaram Port, but exporters say a sharp increase in freight rates and shortages of shipping containers have disrupted export economics. “For many exporters, sending eggs overseas is no longer viable,” said Divya Kumar Gulati, chairman of CLFMA of India, citing mounting shipping costs. The stress is not limited to exports. The crisis is also expected to raise costs for Indian consumers as poultry producers grapple with rising input price. Prices of corn and soybeans, key ingredients in poultry feed, have nearly doubled in recent months. Industry executives expect supplies to remain tight until the next harvest cycle in October-November, which will keep pressure on poultry farmers. Higher fuel prices have added another layer of strain by increasing transportation and packaging costs. Plastic packaging materials, which are closely linked to crude oil prices, have also become more expensive. The government has raised fuel prices by nearly Rs 8 over the past two weeks. Even so, some industry participants believe the domestic market may cushion part of the export slowdown. India’s annual egg production is estimated at 149.11 billion eggs, of which roughly 95 percent to 98 percent is consumed domestically.

Poultry output to fall 25% as rising soybean meal prices squeeze margins

In a step that could have a bullish impact on prices, a large section of India's poultry industry has decided to reduce production by 25 per cent with immediate effect amid a sharp rise in feed costs and the traditional decline in demand during the festival period of July-October, the All India Poultry Breeders' Association (AIPBA) said on June 4, 2026. A decision in this regard was taken at a recent meeting chaired by AIPBA Chairman Bahadur Ali, which discussed the severe crisis facing the poultry sector due to the sharp increase in soybean meal prices. The meeting noted that soybean meal prices have risen more than 40 per cent over the past month, significantly increasing feed costs and putting immense pressure on poultry producers across the country. "Considering the steep rise in production costs, along with the traditional decline in chicken consumption during the months of July, August, September and October due to festivals such as Sawan, Navratri and Durga Puja, the industry has decided to reduce poultry production by 25 per cent with immediate effect," the association said in a statement. As part of this corrective measure, culling of parent breeder stocks has commenced across the country. Breeder birds, which were earlier being sold at around Rs 140 per bird, are now being sold at nearly Rs 65 per bird in an effort to liquidate excess stock. Industry

representatives observed that "the increase in soybean prices is primarily the result of hoarding and speculative trading, despite domestic production being sufficient to meet the country's requirements". They also alleged that during the sale of soybean stocks held by Nafed, a small group of stockists allegedly drove up prices through speculative activities. "The matter will be taken up with the central government." Poultry industry associations have also reiterated their demand for allowing the import of GM soybean meal to help stabilise feed prices. The industry remains hopeful that the government will take timely measures, including permitting GM soybean meal imports, to provide relief to poultry farmers and ensure stability in the sector.

GCAW Launches India Cage-Free Egg Initiative with Industry Partners to Strengthen Supply Chain

The Global Coalition for Animal Welfare (GCAW), a corporate-led coalition focused on advancing animal welfare across food supply chains, has launched a new initiative in India aimed at supporting the development of cage-free egg supply in partnership with Global Food Partners (GFP). The initiative seeks to help companies implement their cage-free egg

commitments in India, which is the world's second-largest egg producer with an estimated 627 million hens, according to the Department of Animal Husbandry and Dairying (DAHD, 2025). The project will focus on addressing market challenges including fragmented supply chains, limited availability of certified cage-free production, and the need for greater coordination among buyers and stakeholders. Participating GCAW members currently include Compass Group, Elior Group, and Sodexo. GCAW has also invited additional companies with cage-free egg commitments in India to participate in the initiative. The programme will be implemented in collaboration with Singapore-based consultancy Global Food Partners, which works with egg producers and food businesses across India and Asia on cage-free sourcing and production systems. GFP will serve as the in-country technical partner, supporting supplier mapping, stakeholder engagement, and market intelligence. The initiative will adopt a pre-competitive and collaborative framework focused on strengthening cage-free egg availability in India. Key areas of work include mapping demand for cage-free eggs among participating companies, identifying and assessing existing and potential suppliers, engaging with industry and government stakeholders, and developing a practical roadmap to expand supply capacity. By aligning companies with shared sourcing commitments, the initiative aims to improve visibility of demand and encourage coordinated efforts toward scalable cage-free egg production in the country. Although India is the largest egg-producing nations globally, commercial-scale cage-free egg production remains limited.



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Feeding The Future - Sustainable Gut Health in Poultry

Dr. Nikhil Nalabale, MVSc Scholar

Introduction:

India's poultry sector has undergone a great metamorphosis and emerged as a world leader in poultry meat production with a production of almost 4.89 million tons annually. Worth a whopping ₹539.65 billion, the market can only increase, reaching ₹625.63 billion in 2030. For eggs, India produced an enormous 142.77 billion eggs in 2024 and is the second-largest egg-producing nation in the world. Now, almost 85% of this increasing production comes from commercial layer and broiler farms, indicating the shift of the industry from traditional backyard production systems to high-level, modern production systems. Intensive systems, however, are susceptible to enteric disease and disruption of beneficial microbiota that inhibit growth and production. The GIT is not just the place for digestion of nutrients and absorption, but also a critical immune organ and reservoir of microbes. Healthy gut will enhance egg production, eggshell quality, and minimizes zoonotic risk e.g. Salmonella in eggs in layers. Gut disorders, however, result in poor feed conversion, diarrhea and mortality.

Historically, sub-therapeutic antibiotics or antibiotic growth promoters (AGPs) have been used by poultry farmers to stimulate growth and gut function. AGPs in poultry feed were legally prohibited in India with a compulsory withdrawal period in 2012, and a comprehensive AGP ban on

layer feed was initiated in 2023. These policy interventions, along with other growing global concern for antimicrobial resistance, have led industry stakeholders and researchers alike to look for alternatives. Most feed companies and integrators have reduced the use of antibiotic growth promoters and are now looking to use natural alternatives like probiotics, prebiotics, enzymes, yeast, organic acids, and essential oils, among others. Therefore, the focus has been on feed additives and management strategies that naturally improve gut health without the application of any AGPs. Probiotics, prebiotics, synbiotics, phytobiotics, organic acids, enzymes, and enhanced biosecurity measures are now being applied to enhance avian health and performance without antibiotics.

Gut Health in Poultry:

The term gut health refers to the structure i.e. villi or crypts, physiology and microbial balance of the gastrointestinal system. A healthy gut has tall, intact villi and a rich beneficial microflora e.g. Lactobacilli, Bifidobacteria in poultry that aid digestion and demote pathogens. In broilers, optimal gut function is critical to support rapid weight gain. Any inflammation of the intestine due to pathogens like Clostridium perfringens caused necrotic enteritis, E. coli, coccidiosis can seriously hinder growth and lead to higher costs of feed. In layers, for eggshell production

extended gut health is required for efficient calcium and phosphorus absorption and to prevent Salmonella colonization that can contaminate eggs. Disrupted gut balance leads to leaky gut, poor feed utilization, and immune stress. Stable microbiota is therefore a necessity.

The purpose of gut interventions is to establish or re-establish the state of eubiosis, thus enhancing gut health and productivity. In Indian tropical climates, heat stress and high stocking density can also challenge gut integrity, so preventive gut management is especially relevant.

Probiotics:

Probiotics are live microbial feed additives e.g. Lactobacillus, Bacillus spp., Saccharomyces yeast that alter the gut flora for the benefit. They act by competitive exclusion of pathogens, increasing the gut barrier, production of antimicrobial factors such as organic acids, bacteriocins and immunostimulation. For instance, addition of Bacillus or lactic acid bacterial strains can decrease gut pH and inhibit colonization by Salmonella or E. coli. In India, several studies have established broiler and layer performance improvements with probiotic additives. A 2025 study (Agustono et al., 2025) found that feeding male layer chickens (MLCs) in the finisher stage with probiotics—namely Lactobacillus acidophilus, L. plantarum, and Bifidobacterium species at a concentration of 4–5 ml/kg

of feed resulted in significant body weight gain, feed conversion ratio (FCR) and nutrient digestibility improvements. Moreover, birds fed with probiotics had improved carcass weight and pectoral muscle growth compared to birds treated with antibiotic growth promoters (AGPs). These improvements are most probably due to gut structure improvements and more effective nutrient absorption. These findings emphasize that probiotics can improve growth and feed use efficiency under Indian conditions as well. a 2024 experiment in Pune, India (Dhokane et al., n.d.), compared the effects of *Bacillus subtilis* addition in White Leghorn layers. Feed addition at 1000 g/ton resulted in higher egg weight (54.15 g vs 52.37 g in the control group), whereas shell thickness and internal egg quality were not affected. Industries in India now commercialize many probiotic products for both broilers and layers, frequently using multiple strains. Field guidance also recommends supplementation with probiotics through drinking water during early life to cause a healthy microbiome, which is extremely helpful in rural or high-stress situations. The Indian feed probiotics market is about ₹817 crore in 2025. It will grow steadily and reach about ₹1,079 crore in 2030, with a CAGR of 5.72% from 2025 to 2030 in the forecast period. ("India Feed Probiotics Market Size, Competitors & Forecast," n.d.)

Prebiotics and Synbiotics:

Prebiotics are non-digestible dietary fiber e.g. mannan-oligosaccharides (MOS), fructooligosaccharides (FOS) / inulin which stimulate beneficial gut bacteria. These enhance *Lactobacilli* and other beneficial microbe numbers resulting in greater short-chain fatty acid (SCFA) production. The SCFAs such as butyrate further acidify the gut

and supply energy to epithelial cells. Indian scientists have reported synergy of prebiotics with probiotics (synbiotics). Trials conducted in Hyderabad, India (Gurram et al., 2022a) reported that broilers given a synbiotic diet (0.01% probiotic + 1% chicory inulin) grew much better than controls. In that trial, the probiotic+chicory group recorded 2185 g weight gain at 42 days (compared to 1975 g in controls) and FCR 1.63 (compared to 1.79).

This blend also led to longer gut villi

Feed Additive	Body Weight Gain (g)	FCR
Control	1975	1.79
Probiotic	2075	1.70
Prebiotic	2100	1.68
Synbiotic	2185	1.63

Table Performance Improvement with Feed Additives

Source: : (Gurram et al, 2022a)

and increased goblet cells, which is a sign of better gut lining. According to such research, the authors conclude that a blend of probiotic, chicory (inulin), and even spice herbs may be employed as a feed supplement for performance and gut health enhancement of broiler chicken. Other prebiotics such as MOS are commonly applied in India. MOS has been reported to bind pathogens and enhance *Lactobacilli*. In layers, synbiotic blends have also raised egg production and gut immunity in trials, by enhancing nutrient absorption and disease resistance.

Phytobiotics (Herbal Additives):

Phytobiotics are plant-derived products herbs, spices, essential oils with health-promoting properties. Many Indian herbs have traditional use, and their bioactive compounds can modulate gut health. For example, coriander (*Coriandrum sativum*) seed powder contains essential oils carvone, limonene, geraniol with broad antimicrobial and antioxidant activity

and which is easily available in India. One study conducted in Hyderabad, coriander exhibited antimicrobial effects against *Salmonella* species and when added to broiler diets contributed to better gut morphology. (Gurram et al., 2022b) Other botanicals like turmeric (*Curcuma longa*), garlic, neem, tulsi (holy basil), and Oregano oil are known to inhibit gut pathogens and reduce inflammation. Some studies shown that supplementation with tulsi or neem extracts have shown slight growth improvements, though more research is needed. In practice, feed formulators in India are increasingly adding standardized plant extracts or essential oils to feeds or water. For layers, herbal products such as Moringa leaf or seaweed extracts have been trialed to improve egg antioxidant levels. Overall, phytobiotics act by disrupting pathogenic bacteria cell membranes, scavenging toxins, and sometimes stimulating appetite or digestion. Medicinal plants and spices are now being adopted worldwide as AGP alternatives.

Phytase superdosing

The process is increasingly being referred to in the science of poultry nutrition as a possible process of enhancing nutrient availability and minimizing phosphorus wastage. In plant-based poultry diets, the most prevalent form of phosphorus is phytic acid (phytate) that complexes with proteins, minerals, and starches, and hence avian species find it hard to digest. As broilers lack the natural capacity to synthesize phytase, the raw phytate escapes their digestive tract, thereby causing environmental pollution. Although traditional uses of phytase bring some improvement, the application of superdosing techniques involving high doses of phytase (usually between 1000 and 3000 FTU/kg) has proved to be more efficient. This process efficiently

degrades not only the major phytate molecule but also its intermediate derivatives, and hence the absorption of protein, energy, and major minerals is enhanced. Apart from that, this process facilitates the release of myo-inositol (MYO), a compound that is crucial in various metabolic processes and improves growth and feed conversion efficiency.

Studies have shown that superdosing with phytase significantly improves broiler performance, especially under conditions where phosphorus in the diet is limited. Phytase superdosing enhances the availability of essential amino acids and results in the reduction of feed conversion ratios (FCR), with MYO being said to account for about 30–35% of these benefits. Overall, phytase superdosing is an economically viable and environmentally friendly measure to maximize feed efficiency and poultry growth, particularly in broiler production systems that are based largely on plant-based feed ingredients.

Phytase: FYT kg	21d (Experiment2)		42d (Experiment1)	
	BWG:g	FCR	BWG:g	FCR
0	931	1.378	2409	1.740
2000	956	1.317	2489	1.696
P	**	**	NS	**

Table 2. Effect of phytase superdosing on performance of broiler chicken

BWG - Body weight gain; FCR - Feed conversion ratio

Source: Walk and Rama Rao, 2018

Organic Acids:

Organic acids (acidifiers) such as formic, acetic, propionic, lactic or butyric acids are added to feed or drinking water to reduce gut pH and inhibit pathogens. In Indian scenarios, where sanitation of feed and water is doubtful, supplementation with acidifiers is adopted. Organic acids lower the pH of the upper gut, preventing growth of *E. coli* and

Salmonella, and are energy substrates for cells of the intestine. A study conducted in 2024, (Sedghi et al., 2024) found that diet supplementation with acidifiers improved broiler performance during the grower and finisher stages resulting in reduction in the population of *Salmonella*, increased length of the tibia, improved expression of FABP1 (Fatty Acid Binding Proteins), PPAR γ , and toll like receptors (TLRs) mRNA inflammatory genes. Acidifiers are available commercially in India. Acidifiers are employed in layers to control pathogens and improve eggshell quality. Organic acids are also reported to improve nutrient digestibility by increasing activity of enzymes and preserving gut structure. Most feed mills now include mixtures of short-chain fatty acids in broiler starter and finisher diets as a routine practice. Use of acidifiers in rural water supply e.g. natural fermentation products such as Lacto fermented herbal extracts is also hereditary in N-E & South parts of India.

Rama Rao et al. (2023) established that feeding broiler chicken with coated sodium butyrate (CSB) at 75 or 150 g/ton is effective in the replacement of antibiotic growth promoters without compromising performance. CSB enhanced the feed efficiency, ileal nitrogen and energy digestibility, bone mineralization, and lowered pathogenic gut bacteria such as *E. coli* and *C. perfringens*.

Treatment	BWG(g)	FI(g)	FI(g)/BWG	Experiment
PC	2489	3835	1.541b	1
NC	2452	3821	1.558a	1
CSB150	2493	3824	1.534b	1
PC	2459	3895	1.584b	2
NC	2448	3930	1.606a	2
CSB75	2492	3900	1.565c	2
CSB150	2497	3900	1.562c	2

Table 3: Performance of Broiler Chickens from 1–6 Weeks with Coated Sodium Butyrate Supplementation on

BWG and FI (Experiment 1& 2) BWG-Body weight gain in gms FI- Feed intake (in gms)

Source: Rama Rao et al 2023

Enzymes:

Exogenous feed enzymes such as phytase, protease, carbohydrases indirectly enhance gut health by maximizing nutrient availability. Phytase added to poultry diets hydrolyzes phytate, releasing bound phosphorus and minimizing indigestible complexes. Not only does this enhance mineral absorption but also minimizes undigested feed substrate capable of stimulating overgrowth of pathogenic bacteria multi-enzyme preparations such as xylanase, glucanase degrade non starch polysaccharides, decreasing gut viscosity and facilitating easier digestion by the gut.

Better digestion results in less fermentable substrate for pathogenic bacteria, with a balanced microbiome favored Improved digestion has been achieved with mixtures of enzymes, and these have been demonstrated to reduce digestive disturbance and even reverse the negative impact of high cereal diets. Enzymes therefore complement other gut-health interventions by maximizing the gut environment. In practice, most commercial layer and broiler diets in Supplementing broiler diets with graded levels of xylanase and α -amylase improved significantly feed efficiency, energy digestibility, and ready-to-cook yield in corn-soybean meal-fed birds. In an ICAR-DPR study, Supplementing broiler diets with xylanase and α -amylase enhanced feed efficiency and energy digestibility. The optimum results were at moderate levels (6,400 u/kg xylanase + 600 u/kg of α -amylase), assisting birds to extract nutrients in corn-soybean meal diets more effectively.

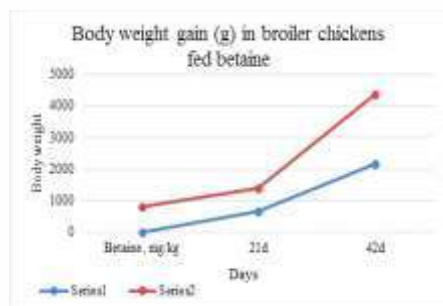
Phage Therapy

Phage therapy is a greener approach to suppressing pathogenic bacteria such as *Salmonella* and *Clostridium* in poultry. It is bacteriophages, or viruses by nature, employed to specifically target bacteria without interfering with the friendly gut bacteria.

Precautions such as Matching the phage with the particular bacterial strain, employing lytic phages and not lysogenic phages, Laboratory testing for safety, maintenance of hygiene, safe handling and storage should be followed for safe and effective application. With these precautions, phage therapy can be an effective alternative to antibiotics in poultry rearing.

Osmolytes:

Osmolytes are rapidly now being viewed as an option to antibiotic growth promoters (AGPs) in poultry feeds. These compounds like betaine, proline, glycine, and trehalose are crucial for maintaining cellular water balance, protein integrity, and gastrointestinal health, especially under stress conditions like heat or dehydration. All these compounds help in improved digestion, maximum nutrient absorption, and speeding up overall metabolic activities, thereby leading to improved growth and feed efficiency.



Graph 1: Body weight gain (g) in broiler chickens fed betaine

Source: (Rama Rao et al, 2011)

In contrast to AGPs, osmolytes pose no

risk to enhance antimicrobial resistance and are therefore a more environmentally friendly and safer option for enhancing poultry performance under antibiotic-free production.

Nano Minerals

Nanoscaled minerals such as zinc, selenium, silver, copper, iron, chromium, and manganese are increasingly being identified with their capacity to promote growth, immune system function, and mineral uptake in avian animals. They are much smaller and have better absorption rates and biological activity compared to their traditional mineral forms. They may be safer and more effective depending on the particular species, the dosage used, and synthesis method.

Nano minerals have also been reported to be inadequate in some studies and, in some cases, less efficient than traditional organic minerals. Moreover, there are also concerns about their safety, and because they are so well absorbed, nanoparticles may cause inflammation of the gastrointestinal tract, interfere with nutrient absorption, or destabilize when fed or stored (FSAI, 2008). In a study carried out by Loghman et al. (2012), the administration of high concentrations of nanosilver (8 and 12 ppm) to broilers caused serious liver injury, thereby again raising questions about the safe use of such products in poultry nutrition.

Alternative Management Practices:

Apart from feed additives, management changes play an important role in gut health. Intensified biosecurity measures like clean housing, restricted access, regular disinfection reduces pathogen load. Good litter management measures like drying, regular turning, litter treatment avoids ammonia and coccidial oocysts.

High water hygiene measures like filtering or sanitizing water, maybe with probiotic or acidifiers avoids enteric infections. Vaccination against common gut pathogens like coccidiosis, infectious bursal disease, Newcastle, etc. indirectly preserves gut integrity by avoiding disease. Nutrition in itself has to be balanced by avoidance of mycotoxin contaminated grains and supplementary feeding with proper vitamins/minerals preserves the gut barrier.

Awareness and trainings:

Training of farmers and regulatory action are essential but India's recent AGP prohibition and attempts by organizations such as CLFMA and research centers such as ICAR-DPR, ICAR-CARI, and veterinary colleges are collectively attempting at least to train producers, farmers on alternatives to the AGP's.

The Compound Livestock Feed Manufacturers Association of India has been instrumental in propagating responsible feeding practices to address the issue of antimicrobial resistance, that of antibiotic growth promoters in particular. It advocates science-based policy and urges the industry to move towards safer and more sustainable alternatives such as probiotics, enzymes, and plant additives. As a separate initiative, it organizes awareness programs and training programs to make stakeholders aware of and implement successfully strategies for AMR mitigation. These initiatives enable the promotion of sustainable animal agriculture and contribute towards national and international efforts in the fight against AMR.

People now a day are very fond of using terms like "organic farming" which involves "antibiotic free organic feed" and the "use of alternate medicines like homeopathy and ayurvedic, probiotics

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etc.” This underscores that in this sectors, traditional remedies are being integrated with modern gut health tools. At the farm level, flock management like lower stocking density, adequate ventilation, stress reduction also contributes to gut well-being.

Conclusion:

Maintenance of gastrointestinal health is the key to sustainability of poultry production. It facilitates efficient feed conversion, stimulates good growth of broilers, improves egg production, and averts enteric diseases.

Following the withdrawal of the use of antibiotic growth promoters (AGPs), management of poultry health in India has been transformed towards an integrated direction: the use of probiotics (useful microbes), prebiotics/synbiotics, phytobiotics, organic acids like butyric acid as gut acidifiers, and digestive enzymes, supplemented by improved management practices.

There is an immediate need to formulate research on some of the new feed additives like Phytase superdosing, Osmolytes, and Proteases in the Indian

context to assess their efficacy under Indian conditions. Also, the effect of the additives on gut microflora, gut health, and other safety factors needs to be researched further.

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Buffalo Reproduction: Understanding Puberty, Estrus Cycle, and Common Reproductive Disorders for efficient milk production

Umesh Kumar¹, D.K. Yadav¹, Dinesh Kumar^{*2} Sanjeev Kumar³ and S. K. Sinha²

Domestic water buffaloes play a crucial role in livestock farming across many countries, particularly in India. They contribute significantly to the agricultural system by providing milk, meat, and draught power, especially in developing nations. These animals are categorized into two main types based on their preferred habitats for wallowing: river buffaloes, which favor running water, and swamp buffaloes, which thrive in stagnant water. Notably, the chromosome counts for these types are 50 for river buffaloes and 48 for swamp buffaloes. River buffaloes are primarily raised for their milk production, while swamp buffaloes are mainly utilized for drafting purposes. Common breeds of river buffaloes include Surti, Murrah, Jafarabadi, and Nili-Ravi, whereas the swamp type does not feature any specialized breeds.

Buffaloes have a significant advantage in their ability to adapt to harsh climates and environments, and they can thrive on low-quality forage. However, these factors can negatively impact their reproductive efficiency. When buffaloes are properly managed and fed, they tend to exhibit good fertility. Effective management of buffaloes requires a complete understanding of their puberty, estrous cycle length, and common reproductive issues. The reproductive organs of buffaloes are similar to those of cattle but have some key differences. For instance, the vulva is tightly opposed, the clitoris is well developed, and the

uterus is smaller and more tightly coiled. Additionally, the cervix is smaller and narrower, making artificial insemination more challenging compared to that of cattle.

In this journeying of buffalo reproduction, we know the intricacies of their puberty, the estrus cycle that governs their breeding behaviors, and the various reproductive disorders that can affect their fertility. Understanding these aspects is crucial for effective breeding practices and overall herd management. We will cover the key stages of puberty, the signaling of estrus periods, and the challenges that may arise in reproductive health, equipping you with essential knowledge for successful buffalo breeding.

Puberty

The onset of puberty in buffaloes can vary significantly, ranging from 16 to 46 months, as observed by Jainudeen and Hafez in 1993. Typically, buffalo heifers reach sexual maturity when they achieve approximately 55 to 60% of their adult body weight, a critical threshold influenced by several factors. Among these factors are nutrition, climate, management practices, genetic variations, the season of birth, and the presence of diseases, all of which can impact both the timing of puberty and the overall growth rate of these animals. In general, buffalo heifers are expected to attain puberty around 24 to 30 months of age, weighing between 225 and 275 kg.

However, there are notable differences between the two primary types of buffalo. River-type buffalo often reach puberty earlier, typically between 16 to 18 months, and usually weigh around 250 to 300 kg at that time. In contrast, swamp-type buffalo tend to mature later, usually between 21 to 24 months, and have a body weight ranging from 200 to 300 kg. This variation underscores the importance of understanding the specific characteristics and needs of each buffalo type to optimize their growth and reproductive success.

Factors affecting puberty

- **Nutrition:** Inadequate feeding delays puberty due to poor body condition and growth rate.
- **Breed Differences:** Genetic variation affects the time to reach sexual maturity.
- **Management Practices:** Good management and housing can help buffalo attain puberty earlier.
- **Seasonality:** Buffalo are seasonal breeders in some regions, and environmental cues such as photoperiod and temperature may delay or advance puberty.

Seasonal breeding activity

Buffalo are seasonally polyestrous animals that display reproductive cycles during specific times of the year. In tropical regions, the consistent

photoperiod influences these cycles. However, hot summer months can lead to heat stress, affecting the productivity and reproductive capabilities of all livestock species. Buffaloes, in particular, are thought to be more vulnerable to heat stress due to their thick black skin, which absorbs more solar radiation, and their sparse hair coat, which fails to adequately insulate them from high temperatures. Additionally, buffalo have poorly developed sweat glands, making them less effective at regulating their body temperature. These unique morphological and anatomical traits contribute to their challenges in thermoregulation.

Oestrous cycle

The oestrous cycle is a regular rhythmic pattern of sexual activity observed in female buffaloes, which begins after they reach puberty. This cycle typically lasts between 17 to 25 days, with an average duration of approximately 21 days. The oestrous cycle is divided into four distinct phases:

1. **Proestrus:** This initial phase involves physiological preparations for mating. It lasts a few days (three days) and is characterized by the development of ovarian follicles, increased levels of estrogen, and noticeable changes in the female's behavior, such as increased restlessness and interest in male buffaloes.
2. **Estrus:** This phase is often referred to as the heat period, during which the female is receptive to mating. It usually lasts for about 12 to 30 hours, marked by behavioral signs such as vocalizations, mounting, and a willingness to stand for breeding. The peak of estrogen production triggers ovulation at the end of this phase.
3. **Metaestrus:** Following estrus, this phase lasts for a few days (3 to 4) as

the female transitions from peak receptivity. The ruptured ovarian follicle forms a structure known as the corpus luteum, which begins to produce progesterone. This hormone is crucial for maintaining pregnancy if fertilization occurs.

4. **Diestrus:** The final phase of the cycle, which lasts until the next proestrus, typically lasts for about 14 days. During diestrus, the corpus luteum remains functional and secretes progesterone to sustain a potential pregnancy. If fertilization does not occur, the corpus luteum degenerates, leading to a decrease in progesterone levels, signaling the start of a new oestrous cycle.

Understanding the oestrous cycle in buffaloes is essential for effective breeding management and improving reproductive performance in herd populations.

Signs of estrus in buffaloes

- a. **Behavioral signs:** Restlessness, bellowing, tail raising, vulvar swelling, decreased feed intake, and frequent voiding of urine are primary signs. It occurs mostly during early morning and late evening, with a peak in the early morning. Heterosexual behaviour and mounting are reliable signs of estrus.
- b. **Expression of signs:** Sign of estrus is more prominent in swamp buffaloes than river breeds. Accurate detection of heat is done by frequent observations (four times a day).
- c. **External genitalia:** Swelling of the vulva, reddening of the vestibular mucosa and disappearance of horizontal wrinkles due to vulval swelling.
- d. **Internal genitalia:** Good uterine tone, coiling of the uterine horns.
- e. **Cervical mucus:** Less copious than in cattle, may not hang as strands

but can be observed through transrectal examination.

- f. **Temporary teat engorgement** Some lactating buffaloes may exhibit temporary teat engorgement (Doka) prior to estrus. Doka is a phenomenon where the teats of lactating buffaloes become temporarily engorged or swollen without the stimulus of milk letdown. This engorgement occurs 2-3 days before the onset of estrus. As the animal approaches estrus, hormonal fluctuations, particularly an increase in estrogen, can cause vascular changes in the udder and teats, leading to temporary swelling.

Some important reproductive disorders

1. Anoestrus

Anoestrus is a reproductive disorder found in cattle and buffaloes, marked by the absence of clear signs of estrus, which may result from either a lack of expression of estrus or difficulties in its identification. It's normal to see anoestrus during certain conditions such as pregnancy, pyometra, fetal resorption, maceration, mummification, lactation, and the postpartum period in adult animals. Generally, the incidence of anoestrus is higher in adult cattle and buffaloes compared to heifers. Notably, the duration of postpartum anoestrus tends to be longer in buffaloes than in cattle, even under similar management conditions. Compared to cows, buffaloes typically have fewer preantral and antral follicles, smaller preovulatory follicles, and a greater likelihood of follicular atresia. Acyclicity is often linked to elevated prolactin levels in the blood, which is believed to disrupt ovarian activity, leading to subfertility and repeat breeding due to insufficient

progesterone production. The infertility resulting from anoestrus can cause significant economic setbacks, including longer inter-calving intervals, diminished calf crop, production losses, increased treatment expenses, and the financial burden of replacing mature animals with heifers.

Diagnosis

Diagnosis is done on the basis of history /complaint of owner like no sign of heat is expressed by animals after attaining puberty or 60-90 days post partum, history of mating/ AI , or owners complaint that they are not able to detect estrus or not seen any signs of estrus in particular animals since long time.

Table 1: Reproductive characteristics of buffalo

Parameters	Means	Range
Age at puberty (months)	30	16-46
Weight at puberty (kg)	275	200-350
Length of oestrus cycle (days)	21	17-25
Length of estrus (hr)	10	5-27
Time of Ovulation		
After onset of oestrus (hr)	34	24-48
After end of estrus (hr)	14	6-21
Length of gestation (days)		
River types	310	300-320
Swamp types	330	320-340
Birth weight (kg)	26	22-36
Involution of uterus (days)	30	25-35

2. Repeat breeding

Repeat breeding constitutes a significant constraint in the dairy industry and presents challenges for farmers. It is a critical factor contributing to reduced reproductive efficiency in buffaloes. The primary causes of repeat breeding in dairy animals include endocrine imbalances, nutritional deficiencies, improper breeding management, early embryonic mortality, and infectious agents that may lead to clinical and sub-

clinical endometritis. Management of this condition typically involves the use of hormonal treatments (such as GnRH and Buserelin acetate at a dosage of 5 ml), mineral supplements, and intrauterine therapies (Metronidazole and Povidone iodine at a dosage of 20-40 ml I/U for 2-4 days, followed by artificial insemination in the subsequent cycle), in addition to antibiotic therapy.

3. Endometritis

Endometritis is a widespread reproductive disorder affecting buffalo, which can have a substantial impact on both milk yield and reproductive efficiency. This condition arises when the inner lining of the uterus becomes inflamed, often due to bacterial infections. To combat endometritis in buffaloes, a variety of treatment options are employed. Antibiotics are frequently prescribed, including cephalosporins, ampicillin, and dicloxacillin, penicillin procaine, and ceftiofur. These medications work to eliminate the harmful bacteria responsible for the infection. In addition to antibiotics, intrauterine treatments may be utilized, involving the administration of gentamicin, oxytetracycline, or penicillin procaine directly into the uterus to target localized infections. Immunomodulators also play a critical role in treatment, with substances such as E. coli lipopolysaccharide, oyster glycogen, bacteria-free filtrate, serum, plasma, or hyperimmune serum being used to strengthen the immune response. Other immunomodulatory agents include levamisole, leukotriene B, granulocyte-macrophage colony-stimulating factor, and human recombinant interleukin-8, all aimed at enhancing the body's ability to fight off infections. Furthermore, zinc oxide nanoparticles (ZnO NPs) are emerging as a promising treatment modality. As a

broad-spectrum antibacterial agent, ZnO NPs are particularly effective against endometritis caused by multi-drug resistant (MDR) bacterial strains, offering a modern approach to managing this challenging condition.

Diagnosing endometritis involves a comprehensive assessment using various diagnostic tools. These include vaginal discharge collection devices that help gather samples, vaginoscopy for visual examination, and the collection of uterine lumen samples for cytological evaluation. Advanced imaging techniques such as ultrasound are employed to detect intrauterine fluid, while the leukocyte esterase test can indicate the presence of infection. Finally, endometrial cytology provides detailed insights into cellular changes within the uterus, allowing for accurate diagnosis and effective treatment planning.

Prolapse of cervix and vagina

The reproductive performance of buffaloes is adversely affected by various diseases impacting the reproductive system, with genital prolapse being a significant issue. Antepartum vaginal prolapse is recognized as one of the primary reproductive disorders in buffaloes, particularly in comparison to other species. This condition, characterized by the prolapse of the vagina, either alone or in conjunction with the cervix, commonly occurs from two months prior to parturition. Research indicates that buffaloes with prolapse frequently exhibit lower serum levels of calcium and phosphorus, suggesting that mineral deficiencies may be a critical factor in the etiology of this condition. Approximately 63% of buffaloes experiencing prolapse have a documented history of this disorder in previous gestations. To address antepartum cervico-vaginal prolapse, several management strategies may be

implemented: the application of management care techniques (including the rope truss method, modification of feed intake, and confinement), use of vulvar sutures (such as simple vulval tape retention sutures or buried purse string sutures), and options for pregnancy termination (two weeks before the anticipated calving date) or induction of

parturition during the last ten days of gestation through the administration of PGF2 α (500 μ g IM) along with Cloprostenol sodium and Dexamethasone sodium phosphate (25 mg intramuscularly).

Post partum reproductive disorder

The incidence of postpartum disorders is more prevalent in river-type buffalo

compared to swamp-type buffalo. Common disorders observed include retained fetal membranes (RFM), which occur in 6-55% of cases, genital prolapse ranging from 2-20%, and metritis, with an occurrence rate of 7-29%. Additionally, various other conditions may affect buffalo, such as dystocia, uterine inertia, and cervico-vaginal prolapse (CVP), which can manifest both pre-partum and post-partum. Uterine prolapse typically occurs postpartum, often within six hours following parturition, and is characterized by a complete eversion of the gravid uterine horn. This condition represents an emergency situation; if not treated promptly, it may result in the death of the dam..

Understanding buffalo puberty, estrus cycle, and common reproductive disorders is critical for improving reproductive efficiency and productivity. Proper nutrition, timely intervention, and sound management practices can help address reproductive challenges and ensure optimal breeding outcomes in buffalo.

Table 2: Different treatment protocols for antepartum cervico-vaginal prolapsed in buffaloes

Degree of prolapse	Stage of pregnancy	Protocol
First degree	Last < 2 weeks of gestation	Managemental care
	Last > 2 weeks of gestations	Managemental care + vulval suture
Second degree	Last < 2 weeks of gestation	Managemental care + vulval suture
	Last > 2 weeks of gestations	Managemental care + vulval suture
	If severe straining	Epidural with Lignocaine + Xylazine
Third degree	Last < 2 weeks of gestation	Managemental care + vulval suture
	If straining continued	Induction of parturition
	Last > 2 weeks of gestation	Managemental care + vulval suture
	If severe straining	Managemental care + Bhuners vulval suture + Epidural Lignocaine + Xylazine
	If severe straining persist	Termination of pregnancy

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Residual Feed Intake: An Eco-friendly Nutritional Selection Tool for Farm Animals

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For many years, genetic selection programs have focused on production (output) traits, with lesser attention given to production costs (inputs). Lately, this view has begun to change and the efficiency of conversion of feed (i.e., the amount of product per unit of feed input) has been recognized as more important. The goal of modern livestock production systems has shifted from targeting merely on productivity enhancement to additionally improving the feed efficiency, that is, similar production at lower intake. Although selection based on feed conversion ratio (feed-to-gain ratio) and feed efficiency (gain-to-feed ratio), respectively, is most common but, these ratios are closely correlated to intake and rate of gain. Residual feed intake (RFI) is a measure of feed efficiency that is independent of body size, growth rate and also considered to represent the inherent variation in basic metabolic processes. Therefore, RFI is a trait used to select for feed use efficiency in farm animals. Efficient animals require less feed than average and can be expected to produce less CH₄ per unit product than the population average at a similar level of production. Animal eating a high-forage diet typically release a greater percentage of their dietary energy as CH₄, and animal with a reduced feed intake emit less CH₄. Developing strategies to reduce CH₄ production from animals have the potential to increase production efficiency and reduce the impact of animals on the environment.

Different measures of feed efficiency:

The term efficiency implies a ratio of outputs to inputs and calculated as a function of individual intake; body weight gain can be appraised by several ways like: feed efficiency (FE), FCR/FCE, gross feed efficiency (GFE), and RFI etc. Due to complex biological processes and the relationship of feed intake to body size and production level, selecting animals based on feed intake alone is rarely used. RFI is an alternate measure of feed efficiency tool and it is defined as the difference between actual feed intake and the expected requirements of feed for maintenance and body weight gain by the animal. It is independent of average daily gain (ADG) and it is fair to moderate heritable ($h^2 = 0.29-0.46$) in nature. So, it has been used as a feed efficiency selection tool in different species.

RFI & its calculation:

The concept of RFI was first introduced to examine a number of indices for calculating efficiency which recognized that differences in both weight maintained and weight gain affect feed requirements in growing cattle. Feed intake could be adjusted for body weight and weight gain, effectively partitioning feed intake into 2 components:

- (1) The feed intake expected for the given level of growth or production.
- (2) A residual portion.

The residual portion of feed intake can be used to identify animals, which deviate from their expected feed intake; the principal RFI determination is calculated as the residuals from the regression of daily feed intake on midtest metabolic BW (MBW) and ADG over a specific period. Actual DMI was computed for each animal and represents the residuals from a multiple regression model, regressing mean DMI on mean ADG and mean MBW. The difference between the observed and predicted DMI is referred as RFI. The base model used as:

$$Y_j = \beta_0 + \beta_1 MBW_j + \beta_2 ADG_j + e_j$$

Where; Y_j , DMI of the j th animal; β_0 , regression intercept; β_1 , regression coefficient on MBW; β_2 , regression coefficient on ADG; e_j , residual error of the j th animal.

RFI is therefore defined as the difference between an animal's actual feed intake and its expected feed intake based on its size and growth over a specified period, with high efficient animal having low (negative) RFI value while, low efficient animal having high (positive) RFI value.

Basis for the variation in RFI:

Approximately 33% of the variation in RFI can be explained by known processes and remaining 67% of variation is believed to be caused by processes in the body including. Five major processes were identified, being those associated with intake of feed, digestion of feed, metabolism (anabolism and catabolism), activity

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and thermoregulation. The proportions of variation in RFI that these processes explain are protein turnover, tissue metabolism & stress (37%), digestibility (10%), heat increment & fermentation (9%), physical activity (9%), body composition (5%), and feeding patterns (2%).

RFI and performance:

Farm animals with high RFI consumed more feed and had a less efficient of feed utilization than low RFI animals. Low RFI calves showed 20.3 % lower FCR compared to high RFI calves in Sahiwal. It was reported in a study that more efficient calves (low RFI) gain desired growth rate by consuming 19% less feed than less efficient calves (high RFI). Accordingly, other studies also reported that animals with high RFI consumed more feed and had a less efficient of feed utilization than low RFI animals. The higher level of DMI in high RFI animals decreases efficiency of dietary nutrient utilization and increases maintenance requirements, more efficient calves required less ME for maintenance than the less efficient calves. Higher maintenance requirement in high RFI animals might be due to increase the amount of energy needed for the digestion of feed, higher heat increment of feeding and heavier visceral organ weights. Whereas, high metabolisability of feed and subsequent decrease of energy expenditure for maintenance and growth might be the reason for lesser feed intake in low RFI animals.

The apparent nutrient digestibilities were more in low RFI animals than high RFI animals and metabolism of nitrogen was significantly higher in high RFI animals. Higher N metabolism in high RFI animals might be due to: 1). Higher N intake 2). Lower DM digestibility 3). Lower N retention and

4). Higher N excretion through urine and faeces (Sharma et al., 2016). Low RFI animals excreted lower urinary and faecal N and had a higher N balance than the high RFI animals (Sharma et al., 2014).

RFI and Environment:

Livestock produce methane and N_2O which are greenhouse gases with global warming potential 21 and 310 times greater than CO_2 respectively. CH_4 is the major livestock greenhouse gas with the bulk being produced as a by-product of enteric fermentation in ruminants. It has been demonstrated that, low RFI animals have multiple benefits, such as decreased DMI, reduce methane emissions (15-30%), and less manure production (15-20%) relative to selection for high RFI animals. Methane production is dependent upon the quantity of feed consumed, although this effect is moderated by feed digestibility and other feed and animal characteristics. The values for CH_4 emission as g/d, g/kg DMI and g/kg digestible NDF intake were lower in low RFI animals as compared to high RFI animals. Improving the feed efficiency has a potential to reduce CH_4 , as genetically efficient animals (low RFI) are reported to emit 11-26% less CH_4 per unit of product or gain. Level of enteric CH_4 production is mainly determined by the fibre content of the diet and the fermentative capacity of the animals. So, it can be inferred that the animals with low RFI will produce less methane while maintaining the productivity and thus contributing to the environment. The results from these studies highlight the potential and opportunity to use selection for low RFI animals as a greenhouse gas mitigation strategy. The most practical and rapid mitigation procedure may be to reduce the per cow CH_4 emission through animal breeding and genetic selection for feed efficiency as it is

permanent and cumulative.

Conclusion:

Today's ruminant production systems demand for the technology that reduces enteric CH_4 at the same time boosting up the farm profit. Furthermore, the suitability of RFI as a selection tool for eco-friendly ruminant production was evaluated. There is conclusive scientific evidence that dairy animals with low RFI consumes less feed at the same level of production as high RFI animals. In addition to reducing feed consumption, animal with low RFI produce less methane from enteric fermentation and also less manure relative to high RFI cattle. Feeding individual animals as per their nutrient need considering individual feed efficiency will maximize efficiency of nutrient utilization in a farm. RFI is the best available measure of efficiency because it is independent of level of production and is moderately to high heritable and so respond to genetic selection. Progeny of cattle selected for low RFI consume less feed for the same level of growth as progeny of cattle selected for high RFI. Cattle tested as low RFI (efficient) during the post weaning period, remain efficient throughout their lives. The reduction in methane production by low RFI cattle is achieved with no major impact on the growth of cattle. It may be more profitable to wait until more research has been done to conclude whether or not low RFI value cattle will perform as better as the high RFI cattle. It concluded that, RFI values are another option to utilize during selection of animals in farm.

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Mealworm meal in aquaculture: A regional approach to feed sustainability in Northeast India

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Northeast India stands at the crossroads of aquaculture opportunity and feed sustainability challenges. With 16.91% of India's rivers and canals, 0.15% of small reservoirs, 0.69% of medium and large reservoirs, 1.63% of ponds and tanks, 38.16% of beels and oxbow lakes, and 55.09% of water bodies other than rivers and canals, combined with a population where over 95% consume fish, the region possesses both the natural resources and market demand for robust aquaculture development. However, the sector's growth has been constrained by a critical bottleneck: the high cost and external dependence on protein-rich feed ingredients. Currently, Northeast India relies heavily on fishmeal and soybean meal imported from other states, with fishmeal costing ₹130-₹160 per kilogram and soybean meal priced at ₹50-₹65 per kilogram. This dependence not only affects farm profitability but also raises questions about long-term sustainability and regional food security. Enter the yellow mealworm (*Tenebrio molitor*) – an innovative solution that aligns with the region's traditional familiarity with insect consumption and offers a pathway to feed self-sufficiency.

Nutritional excellence: mealworms vs. conventional protein sources

The nutritional profile of mealworm larvae presents compelling advantages for aquafeed formulation. Pilot studies conducted in Manipur reveal that

mealworms deliver 45-60% crude protein, comparable to fishmeal's 55-65% range. More significantly, mealworms provide 25-30% crude fat compared to fishmeal's 8-12%, offering higher energy density at approximately 5,000 kcal/kg versus fishmeal's 4,500 kcal/kg. The amino acid composition of mealworm protein particularly stands out for aquaculture applications. Essential amino acids including lysine (3.1-3.4%), methionine (1.0-1.2%), threonine (2.4-2.8%), and arginine (2.5-3.2%) meet the nutritional requirements of commercially important species like *Labeo rohita* and *Cyprinus carpio*. These levels are especially valuable given that lysine and methionine are often limiting factors in plant-based feed formulations. Digestibility studies further reinforce mealworm meal's potential, with apparent digestibility coefficients ranging from 85-92%. This high digestibility not only enhances growth performance but also reduces waste output – a critical consideration for maintaining water quality in intensive aquaculture systems. The beneficial lipid profile, rich in linoleic and oleic acids, contributes to healthy fish tissue development and improved flesh quality.

Performance validation through regional feeding trials

Feeding trials conducted across Northeast India have provided substantial evidence of mealworm meal's efficacy as a fishmeal replacement. Studies with *L. rohita*, *C.*



Figure 1: Yellow mealworm (*Tenebrio molitor*) larvae in their final instar stage, showing the characteristic golden-yellow coloration and segmented body structure.

carpio, and *Pangasianodon hypophthalmus* demonstrated optimal growth and feed conversion ratios (FCR) when mealworm meal replaced 25-50% of fishmeal in formulated diets. The trials revealed several key findings that support commercial viability. Blood profile analyses and histological examinations of liver and intestinal tissues showed no abnormalities up to 50% inclusion levels, indicating excellent biocompatibility. Consumer taste panels detected no significant differences in fillet texture, flavor, or color compared to fish fed conventional diets, addressing potential market acceptance concerns.

A notable pilot project by the ICAR Research Complex for NEH Region in Manipur achieved FCR improvements of 6-8% in *L. rohita* using locally produced mealworm meal. The monthly production of 40 kg dry mealworm from kitchen waste demonstrated the practical feasibility

of integrating insect farming with existing aquaculture operations. While complete fishmeal replacement (100%) showed slightly reduced performance, likely due to amino acid imbalances or chitin content effects, the 25-50% replacement range offers substantial feed cost reduction without compromising fish performance.



Figure 2: Small-scale mealworm production facility at ICAR Research Complex for NEH Region, Meghalaya, demonstrating low-cost rearing techniques suitable for rural farmers in Northeast India.

Economic viability and production feasibility

The economic case for mealworm adoption in Northeast India rests on both cost reduction and local production capabilities. Estimated production costs for small-scale mealworm meal range from ₹85-₹100 per kilogram when utilizing agricultural waste substrates – a significant saving compared to imported fishmeal prices. The production system's accessibility represents a major advantage for smallholder farmers. Initial setup costs of ₹12,000-₹15,000 for a 20-tray unit make mealworm farming accessible to rural entrepreneurs, women's self-help groups, and farmer cooperatives. The technology aligns well with the region's tropical to subtropical climate, with ambient indoor temperatures of 22-30°C supporting year-round production. Preliminary observations from Bishnupur and Thoubal districts

in Manipur demonstrate successful household-level production using wheat bran, kitchen waste, and dry vegetable peels. This integrated approach not only reduces feed costs but also addresses organic waste management challenges common in rural areas.

The waste-to-biomass conversion efficiency of over 40% under Northeast Indian conditions highlights the system's resource utilization potential. Mealworms efficiently convert organic waste streams into high-protein biomass, while producing nutrient-rich frass suitable for use as organic fertilizer, creating additional revenue streams for farmers.

Environmental sustainability and circular economy benefits

Life cycle assessment studies consistently demonstrate mealworm farming's environmental advantages over conventional protein sources. Land use requirements are significantly lower due to vertical rearing systems, while water consumption remains under 1,000 liters per kilogram of protein compared to fishmeal's 5,000-10,000 liters. Carbon dioxide emissions range from 2-5 kg per kilogram of protein, substantially lower than fishmeal's 14-20 kg emission rate. The circular economy potential of mealworm systems particularly suits Northeast India's agricultural landscape. By utilizing organic waste streams including brewery waste, food processing byproducts, and agricultural residues, mealworm farming reduces environmental burden while creating value from materials that would otherwise require disposal. This approach aligns with Sustainable Development Goals for waste minimization and rural circular economies. The integration of mealworm production with existing

farming systems – combining fish farming, poultry, and vegetable cultivation – exemplifies the holistic approach to sustainable agriculture increasingly valued in modern feed production.



Figure 3: Dried and processed mealworm meal ready for incorporation into aquafeed formulations.

Implementation challenges and market barriers

Despite promising technical and economic indicators, several constraints limit widespread mealworm adoption in Northeast India's aquaculture sector. Technical knowledge gaps represent the primary challenge, as most fish farmers lack experience with insect rearing techniques. Maintaining optimal humidity (65-70%) and temperature (25-30°C) requires skills and infrastructure adaptations that differ significantly from traditional aquaculture practices. Regulatory uncertainty poses another significant barrier. As of 2025, insect protein lacks clear recognition under India's Food Safety and Standards Authority (FSSAI) feed regulation framework, creating uncertainty for commercial-scale operations. The absence of standardized guidelines for microbial load, heavy metal content, and pesticide residue screening

complicates quality assurance efforts. Economic scaling challenges emerge beyond household-level production. While small-scale operations remain accessible, larger commercial ventures require controlled environment systems, specialized lighting, and standardized rearing infrastructure that demand substantial capital investment. The lack of established procurement networks and cooperatives for mealworm meal, unlike existing systems for soybean and rice bran, affects price realization and farmer engagement. Socio-cultural factors also influence adoption rates. Many traditional farmers associate insects with pests and waste, creating resistance to their use in feed production. Consumer awareness remains limited regarding fish quality from insect-fed systems, necessitating market education and trust-building initiatives. Biosecurity considerations require careful attention, particularly when mealworms are reared on organic waste near livestock units or fishponds. Proper hygiene protocols and waste processing procedures are essential to prevent microbial

contamination or heavy metal accumulation.

Future prospects and strategic recommendations

The trajectory for mealworm integration in Northeast Indian aquaculture points toward gradual but significant market penetration. Industry projections suggest potential replacement of up to 50% of fishmeal imports with locally produced insect protein by 2050, contingent on appropriate support systems and policy frameworks. Research priorities should focus on species-specific feed trials with varying inclusion rates for commercially important species. Amino acid balancing using locally available plant proteins such as mustard cake and rice bran will optimize nutritional profiles. Developing chitin mitigation technologies through enzymatic treatment or defatting processes will improve digestibility at higher inclusion levels.

Policy support mechanisms are crucial for sector development. Regulatory clarity from FSSAI and ICAR regarding

insect protein use in aquafeed will facilitate investment and commercialization. Integration into government schemes including the Blue Revolution, Rashtriya Krishi Vikas Yojana (RKVY), and North East Livelihood Promotion Society (NELPS) could accelerate awareness and adoption. Training programme development through Krishi Vigyan Kendras (KVKs), State Agricultural Universities, and rural livelihood missions will build technical capacity among farmers and entrepreneurs. Community resource centers providing rearing equipment, starter colonies, and market linkages will support systematic adoption. Market development strategies should emphasize consumer education through awareness campaigns, fish fairs, and local media to address misconceptions about insect-fed fish quality. Implementing labeling standards for "sustainably-fed fish" will create premium market segments for environmentally conscious consumers.

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Factors Involved in Post Weaning Diarrhea and Measures to Mitigate it.

Dr. Hrishikesh Tekade, , MVSc

Modern Pig Production

Pigs (*Sus domesticus*) are among the most important livestock species for global meat production due to their high prolificacy, efficient feed conversion, rapid growth, high dressing percentage, and short gestation period. Despite these advantages, the weaning phase remains the most challenging period in pig production, often leading to health and growth setbacks.

The role of the GIT

The gastrointestinal tract (GIT) in pigs is highly dynamic, playing essential roles beyond digestion and nutrient absorption, including fluid balance, enzyme and mucin secretion, immune defense, and maintaining a barrier against pathogens. Its function relies on complex interactions between nutrition, the mucosal membrane, and gut microbiota, all critical for overall pig health and productivity. During the commercial production cycle nursing, nursery, growing, and finishing, pigs face their greatest challenges at weaning, when they transition from sow's milk to solid feed and encounter numerous stressors: declining passive immunity, abrupt separation, transport, new diets, social mixing, and increased pathogen exposure. These stressors often lead to reduced feed intake, which, combined with immature digestive and immune systems, predisposes piglets to gastrointestinal disturbances, growth

retardation, diarrhea, and higher mortality. Rapid adaptation to these challenges is crucial for piglet health and efficient production.

Results of several studies have demonstrated that weaning in pigs induces a breakdown in intestinal barrier function characterized by a significant decline in intestinal trans-epithelial electrical resistance and increased permeability to paracellular probes in Ussing chamber experiments. Enterotoxigenic *Escherichia coli* (*E. coli*) is a significant pathogen responsible for causing enteric diseases in both humans and animals. In pigs, infection with F18+ *E. coli* in weaned pigs triggers inflammation and oxidative stress, damages the villi in the jejunum, and disrupts the intestinal barrier. These effects lead to post-weaning diarrhea and impaired growth performance in affected animals (Duarte et al., 2024).

However, implementing improved animal management protocols and a targeted dietary approach to enhance intestinal health and development during the weaning phase can effectively reduce the occurrence of post-weaning diarrhea without relying on medication.

Factors involved in post weaning diarrhea and their mitigations.

1. Diet composition

• Reduced feed intake and Importance of creep feed:

Reduced feed intake immediately after weaning leads to negative changes in piglet intestinal morphology, such as shortened villi and decreased enzyme activity, impairing nutrient absorption and gut barrier function, and increasing the risk of diarrhea and growth retardation. Early and sufficient feed intake post-weaning is crucial for gut health and overall performance.

Offering feed with a consistency closer to milk, such as liquid feed or supplemental piglet milk, can help maintain feed intake during the transition, resulting in higher weaning weights and improved post-weaning growth. Providing creep feed before weaning also supports gut maturation by stimulating digestive enzyme activity (e.g., pancreatic enzymes and brush border enzymes) and microbiota development, making piglets better prepared for the dietary shift and improving nutrient digestion and absorption after weaning. This indicates that piglets consuming creep feed during the weaning period develop a more mature digestive system, enabling them to digest and absorb nutrients more effectively than those not given creep feed, while their gut microbiota attains increased resilience to disruptions caused by weaning.

• High Protein:

After weaning, piglets require high protein intake for growth and immune

function, but their immature digestive systems cannot fully digest excess protein. Undigested protein ferments in the hindgut, producing ammonia, polyamines, indoles, and phenols, which raise intestinal pH, promote pathogenic bacteria like *E. coli*, and increase the risk of diarrhea by disrupting gut health and electrolyte balance. Toxic byproducts such as cadaverine and putrescine further exacerbate diarrhea and intestinal inflammation. Reducing dietary crude protein (CP) as much as possible (without compromising performance), balancing essential amino acids, and using highly digestible protein sources can significantly lower post-weaning diarrhea (PWD) incidence (Wang et al., 2018).

Additionally, supplementing with feed enzymes like proteases and adding organic acids such as benzoic acid to lower gut pH are effective strategies to improve protein digestibility and control PWD (Diao et al., 2014).

Earlier studies have demonstrated that functional amino acids, including arginine, cysteine, glutamine, and glutamate, can improve immune function in the intestinal mucosa (such as boosting sIgA secretion), mitigate oxidative stress, stimulate proliferation of enterocytes, and strengthen the gut barrier (via heightened expression of tight junction proteins) in weaned piglets.

• Soluble Fiber:

While fiber in general is beneficial for gut health, a high proportion of soluble fiber can increase gut viscosity. Increased viscosity can slow down the passage of digesta through the intestines. This slower transit time can create an environment conducive to pathogenic bacterial overgrowth, including potentially harmful bacteria.

Insoluble DF primarily acts in the large intestine by increasing faecal bulk and passage rate, modulation of the large intestinal microbiome, and increased production of short chain fatty acids (SCFAs), which may positively affect gut health. Insoluble fibre sources decrease digesta retention time in the proximal GI-tract, which, in turn, may reduce the proliferation of pathogens in the small intestine, and thereby, especially relevant to reduce the risk of suffering from PWD. It is also suggested that fibre sources which resemble host receptors might interrupt the adherence of bacteria to the intestinal mucosa, thereby reducing *E. coli* proliferation in the small intestine by blocking *E. coli* adhesion to the gut epithelial cells.

It's important to have a balanced fiber content with the right proportions of soluble and insoluble fiber. Dietary inclusion of carbohydrases (xylanase, β -glucanase) which increase the in vivo availability of short-chain oligosaccharides has beneficial effects on gut health, and thus preventing PWD.

• Antigenic proteins:

It has been reported that the presence of some ingredients in the feed for weaners, such as soybeans, seems to favor the occurrence of PWD. This could be due to the presence of trypsin inhibitors or antigens inducing a localized immune response. Soybean glycinin and β -conglycinin, the predominant antigenic proteins in soybeans, serve as two key antinutritional factors linked to post-weaning diarrhea in piglets. Furthermore, research demonstrated that soybean meal (SBM) lowers the duodenal specific activities and increases crypt depth in pigs, indicating that such components should be excluded from the diets of early-weaned piglets.

Feedstuffs processing mainly includes physical methods (expansion, heating, mechanical processing), chemical methods (acid and alkali treatment, alcohol solution treatment, salt treatment), and biological methods (biofermentation, enzyme treatment, breeding). Most feedstuffs processing methods, including biofermentation, bulking, enzyme treatment, not only reduce or inactivate antigenic proteins and pathogens, but also physically alter the raw material through agglomeration or hydrolysis, thereby enhancing feed digestion and absorption.

2. Low Sanitary Conditions:

Maintaining a clean and hygienic environment is paramount in preventing the spread of pathogens and supporting the health of young animals:

- **Pathogen Bacterial Load:** Poor sanitation leads to a higher concentration of pathogenic bacteria in the environment. Young, recently weaned animals have developing immune systems and are more susceptible to these pathogens. Exposure to a high bacterial load can overwhelm the gut's defenses, leading to infection, inflammation of the intestinal lining (enteritis), and consequently, diarrhea. Common pathogens involved can include *E. coli*, *Salmonella*, and *Clostridium* species.
- **Gut Inflammation:** The presence of pathogens and the body's immune response to them trigger inflammation in the gut. This inflammation disrupts the normal absorptive and digestive functions of the intestine, leading to malabsorption of nutrients and increased fluid secretion, resulting



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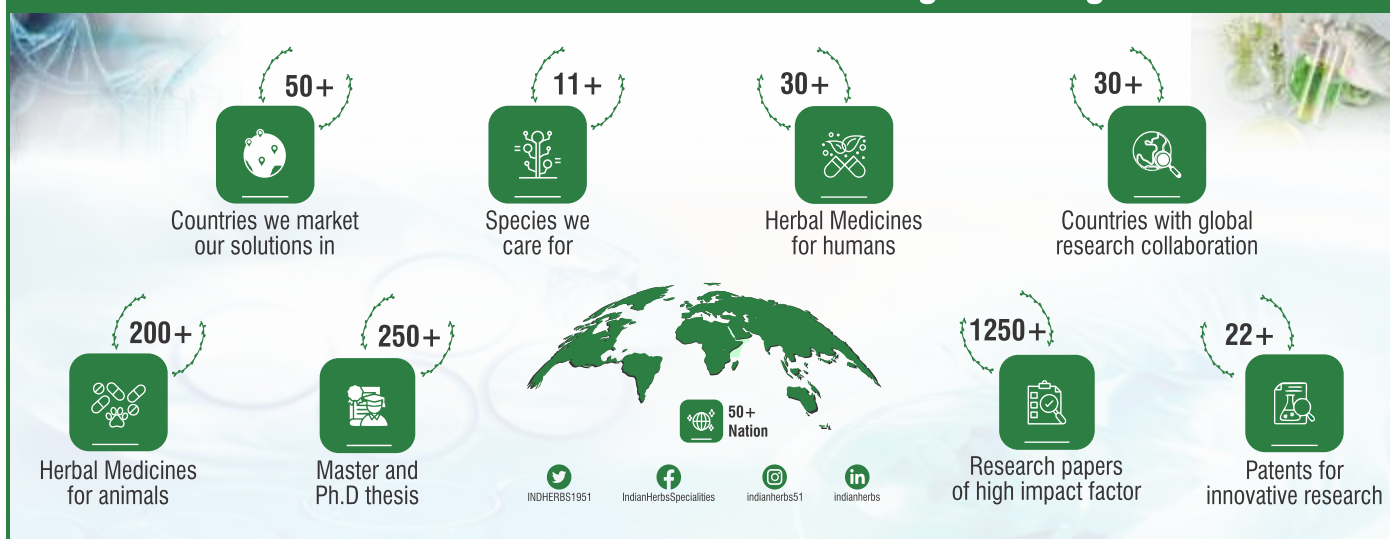
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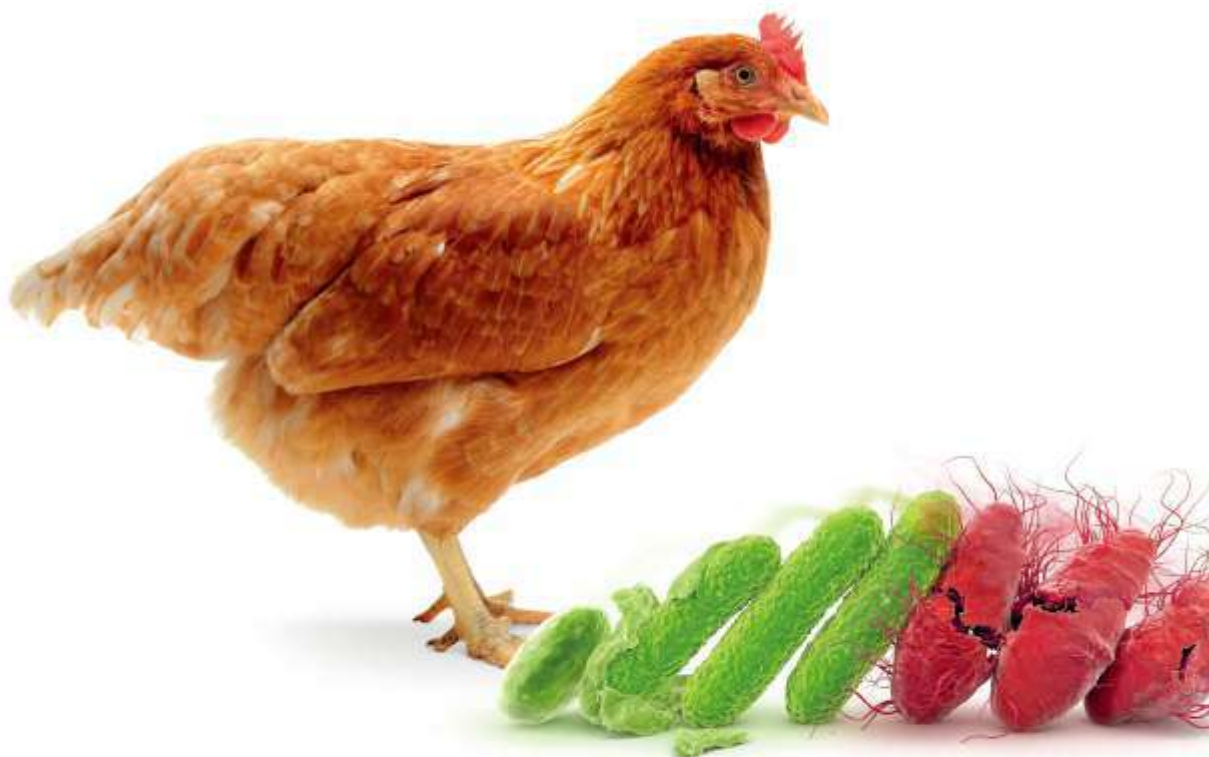


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in diarrhea. Chronic inflammation can also damage the intestinal villi, further impairing nutrient uptake and exacerbating the condition.

Studies have shown that piglets reared under unclean conditions experience higher levels of ammonia and hydrogen sulfide in the environment, which can lead to distress, reduced feed intake, and impaired gut morphology, such as shorter villi and shallower crypts—factors linked to poorer growth and higher diarrhea incidence (Jayaraman et al., 2016).

Maintaining high standards of cleanliness in the nursery is critical for optimal performance of piglets partly because of its direct or indirect effects on gut health and function.

3. High Temperature and Low Ventilation:

- During the post-weaning period it is essential to provide the correct environmental temperature (26–28°C) to keep pigs in their thermo-neutral zone. A high ambient temperature reduces intestinal peristaltic activity due to a decrease of blood flow in the GIT and a reduction in the supply of oxygen. This leads to intestinal hypoxia, inflammation, oxidative stress and promotion of bacterial colonization.

Cold conditions in weaner housing may exacerbate the severity of post-weaning diarrhea (Rouma et al., 2017). While effective ventilation helps to eliminate moisture, harmful gases, and partially regulates animal house temperatures. Ventilation determines air velocity at pig level and therefore plays an important role in the rate of heat loss, especially in young pigs. Eriksen et

al. (2022) described an association between high ventilation index score and low PWD occurrence.

4. Stocking Density:

- High stocking density in pig pens can negatively impact piglet health and growth by increasing competition for feeder space, which reduces feed intake and growth performance—both crucial for gut development. Overcrowding also elevates stress, as indicated by higher plasma cortisol levels, and leads to compromised gut barrier integrity, with increased intestinal permeability and inflammation, raising the risk of diarrhea. Additionally, high density promotes oxidative stress and facilitates rapid pathogen spread, further challenging the immune system and increasing disease risk. Studies show that reduced space allowance results in shorter villi and poorer gut morphology, while more space supports better intestinal health and performance. A recommended minimum space allowance for weaned pigs is at least 0.34 m² per pig in slatted pens, though higher allowances may be needed in antibiotic-free systems (AAFC, 1993).
- Mixing piglets from different farms at weaning is common but often leads to aggressive behavior as pigs establish dominance, especially in the first few hours after grouping. This aggression can cause significant differences in food and water intake among individuals, impacting welfare and growth. Grouping piglets by sow parity or pre-weaning socialization—where piglets interact with non-littermates before weaning—can reduce aggression and help to form

stable social hierarchies, thereby minimizing stress and disease risk after weaning by reducing variation in the immune status of the piglets.

5. Infection:

- PWD (post-weaning diarrhea) is a multifactorial disease often involving mixed infections, with rotavirus and *E. coli* among the most prevalent pathogens in weaned piglets, along with coccidia, sapovirus, and *Cryptosporidium parvum*. Also porcine reproductive and respiratory syndrome virus (PRRSv) and mycotoxin can further increase susceptibility to severe outcomes from enterotoxigenic *E. coli* (ETEC) infections.
- Traditional approaches to combat infections have relied heavily on the use of antibiotics. However, the overuse and misuse of antibiotics have contributed to the emergence of antibiotic-resistant strains, posing a serious threat to both human and animal health.
- Strategies such as the addition of organic acids, plant components with antibacterial effects, antimicrobial peptides including bacteriocins, single-domain antibodies (nanobodies), bacteriophages, probiotics, fibre, and strategies that reduce the stomach/small intestine lumen pH, such as fermented liquid feed coarsely ground feed and mycotoxin binder, could be candidates to inhibit or reduce the growth of ETEC.
- Vaccination can be an effective approach to reduce the occurrence of PWD and to reduce infection pressure and increase immunity in the pig population.

- Addition of Probiotics, Prebiotics, Synbiotics to creep diet increases the chance of modulating the gut microbiota to improve gut health/robustness to disease.
- Biosecurity measures that reduce the risk of disease agents being introduced and spread in an animal and its environment can be followed. Biosecurity includes bio-exclusion, bio-containment, and bio management (Levis and Baker, 2011). Bio-exclusion (also known as external biosecurity) is preventing the entry of undesirable pathogens into the farm. Bio-management is the combined effort to control economically infectious diseases that are already present in the farm population. Proper cleanliness and disinfection of the pig rooms, vaccinations, all-in/all-out pig movement are some of the important procedures to minimize the pathogen build-up or

enhance immunity levels in the pigs are the key components of bio management.

5. Boosting antioxidant and anti-inflammatory capacity:

- Enhancing antioxidant capacity is vital for managing post-weaning diarrhea (PWD) in piglets, as it helps counteract oxidative stress caused by weaning-related challenges such as dietary changes and environmental stressors. Antioxidant supplementation using vitamins (E, C), minerals (selenium, zinc), and natural compounds like tannic acid reduces reactive oxygen species, supports mitochondrial and intestinal barrier function, and fosters a healthier gut microbiota, collectively lowering inflammation and the risk of diarrhea. These nutritional strategies not only improve gut health and resilience

but may also reduce reliance on antibiotics in pig production.

Conclusion

Enteric disease in pigs results from a complex interplay between environmental pathogen load, the pigs' immune competence, and environmental stressors, making disease control a significant challenge for producers. While it is impossible to eliminate all disease risk, adopting improved husbandry practices—including enhanced sanitation, optimal stocking density, environmental management, dedicated nutrition, and robust biosecurity can significantly reduce disease incidence. These strategies promote healthy gastrointestinal development and function, helping to prevent gut disturbances such as piglet diarrhea.

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Next-gen Technologies Revolutionising Animal Disease Diagnosis

Dr.R.N.Sreenivas Gowda

Introduction

In today's fast-moving tech world, a constellation of disruptive technologies are driving a digital revolution in animal health care. Many new technologies have quickly advanced the way animals are cared for. Innovations range from artificial intelligence (AI) designed for predictive diagnostics to Internet of Things (IoT)-based wearable devices that can monitor poultry, livestock and pets in real-time, and telemedicine enabling remote consultation to genomics aiding the formulation of personalized care routine. This is no longer science fiction—it's the emerging reality of next-gen animal health care.

New technologies are rapidly improving animal disease diagnosis, offering faster, more accurate, and more reliable methods. These advances include molecular diagnostics like PCR and Next generation sequencing (NGS), along with AI-powered tools for image analysis and predictive diagnostics. Additionally, biosensors and telehealth applications are expanding the range of diagnostic possibilities.

Such new technologies signify a new era in disease knowledge, in which discovering new information enabling more accurate predictions can lead to faster responses and greater control of potentially devastating disease crises.

The veterinarian also be prepared to use latest technological advancements with digital knowledge.

This article deals with some of the advancements taken place in animal

disease diagnosis in digital technology in veterinary science.

New technologies:

a) Sensor Technology

Sensors are the heart of modern poultry / dairy farm monitoring. These devices, when strategically placed, continuously collect data on body temperature, sounds, behavior movement, climate changes inside the poultry house can monitor the light intensity, level of humidity, CO₂, and ammonia etc. and other critical parameters. Real-time information enables farmers to make informed decisions, ensuring optimal conditions for animals.

b) Wearable devices:

These devices allow for early diagnosis and smarter treatments that help improve the overall health and well-being of animals. Whether dairy cows on smart farms or domestic animals, technology and AI are transforming animal care, giving veterinarians, researchers, farmers, and animal owners access to more accurate, personalized, and predictive health care for animals.

c) Artificial Intelligence(AI) and Machine Learning(ML)

Artificial intelligence (AI) is a computer simulation of human intelligence processes, such as learning, reasoning, and self-correction, to solve a problem or perform a task. Instead of a brain, computers have algorithms, a series of step-by-step instructions for "thinking" about data inputs to achieve the

desired goal.

AI has emerged as a game-changer, offering solutions that improve efficiency, productivity, and animal welfare. The Role of AI in Poultry Farming. AI-driven technologies provide farmers with powerful tools for disease detection, environmental control, feed optimization, and farm automation.

Machine learning is a subsection of AI where the algorithm isn't given a set of instructions, but rather trained on data to make decisions or predictions on its own.

AI powers numerous innovations in animal health care. It can examine intricate patterns from diagnostic images, genetic information, and even behavioral data through machine learning algorithms.

- **AI in veterinary medicine:** These AI algorithms can already outperform human specialists when interpreting X-rays and MRI or CT scans. Some algorithms can even discriminate fractures, tumors, or organ anomalies much faster than humans can, occasionally with improved accuracy.
- **Predictive analytics:** In livestock management, peripheral AI applications are capable of predicting disease outbreaks. For instance, in dairy farming, mastitis outbreaks can be predicted well ahead of time, allowing timely farmer intervention to avert escalation.

- **Chatbots and virtual assistants:** Some veterinary clinics have embraced AI-powered chatbots and virtual aides that are capable of triaging patients, managing appointment calendars, giving basic medical advice, and answering basic questions posed by clients.

d) IoT technology in animal health

Agriculture implements IoT through use of robots, drones, sensors, and computer imaging integrated with analytical tools for getting insights and monitor the farms. Placement of physical equipment on farms monitors and records data, which is then used to get valuable insights.

- **Wearable IoT devices for pets:** Smart pet collars and vests come with sensors that monitor a pet's vital signs such as heart rate, temperature, and levels of activities. If something goes wrong, an alert is sent to your veterinarian or your phone.
- An IoT sensor can detect changes in body temperature and other manifestations of disease in birds. Real-time data analysis enables farmers and company veterinarians to swiftly detect and respond to irregularities, and just as importantly, plan for potential outbreaks.
- **Livestock IoT devices:** Smart cattle ear tags, boluses, and ankle bracelets enable monitoring of herd health and aid in strategizing optimal feeding, fertility cycles, and disease management.
- **Environmental IoT monitoring:** Specialized sensors can track temperature, humidity, and air quality in barns, taking care of animals' optimum conditions.

e) Telemedicine: Veterinary care without borders

- Just like human health care services were transformed by

telemedicine during the COVID-19 pandemic, this virtual form of care is also changing how veterinarians interact with patients.

- **Video consultations:** Now, clients can book a video call with a veterinarian, making it smoother to seek expert opinions for minor issues, postoperative care, or second opinions.
- **Tele-triage services:** Dedicated health care apps offer veterinary support around the clock to guide owners on whether an urgent visit is needed or whether home care will suffice.
- **Health records mobile applications:** With a health-record-based mobile app, owners can digitally store and share vaccination records, medications, and medical histories, facilitating communication between veterinarians and clients.

f) DNA Mapping

The breeding process has also been revolutionized by technological innovation. Advancements made in DNA mapping and animal health diagnostic tools over the last few decades provide today's chicken breeders with access to an abundance of data regarding the health and genetics of the birds under their care. This data is instrumental in the breeding process.

- DNA tests to check for any genetic disorders down the line
- Blood oxygen level tests to ensure heart and lung health
- Ultrasounds to examine breast muscles.
- X-rays of joints. Leg and joint health are important traits to improve over each generation, as birds need strong legs and joints in order to easily access their feed and water and grow to their full potential.

g) Genomics and precision medicine: Custom fit treatment at genetic sequencing level. One more change on the horizon is genomics—the study of an animal's genetic code to optimize health care.

- **Breed-specific insights:** Testing patients with a DNA testing kit can reveal specific traits in the animal, such as habits and allergies.
- **Milestones:** More sophisticated treatments are using stem cell therapy, using the animal's own fat cells for enhanced efficacy.
- **Advanced genomic breeding for agricultural animals:** Genomics enables the selective breeding of more productive and resilient agricultural animals, resulting in decreased overall diseases and improved profits.

h) Drones and surgical robots:

- Drones equipped with high-resolution cameras and environmental sensors are transforming how animal farms are managed. Seen as a far-fetched dream not too long ago, robotics in animal health care is an everyday reality.
- They provide an aerial view of the farm, monitor animal behaviour, identify potential issues, and assess the health of the animals.
- They are used to spray insecticides to keep healthy environment in the farm
- **Computer-assisted surgeries:** It enhances the skill of veterinary surgeons, and robotic arms are deployed during key-hole surgeries.
- **Robotic systems in agriculture:** Drones are used for monitoring and controlling bovine households. Milking, cleaning barns, and even sickness detection are now automated.

- Because of the enhanced capabilities of AI and machine learning, robotics is playing a larger role in the administration of care and facility maintenance. Robotics equipped with robust AI capabilities are working as surgical assistants and delivery and transportation aids.
- **Sound detection technologies** use microphones and sound analysis to monitor and identify audible signs of illness, such as coughs or respiratory changes.
- **Thermal imaging** uses heat sensors and cameras to monitor changes in temperature within groups of animals down to specific body parts such as hoofs and udders.
- **Smart ear tag devices:** can track the feeding, temperature, behaviour and movement of livestock and monitor vital signs for early indications of illness, heat detection and fertility – and transmit this information every 20 minutes, providing an accurate and up-to-date picture of each animal's health. This data then feeds into a system that alerts a farmer or veterinarian as soon as there is a change that could be an early sign of illness or a change in health status.
- **47% of poultry farmers** in Switzerland reported used smartphones to monitor chicken barns.
- In recent years, the landscape of molecular diagnostics in veterinary practice has been profoundly influenced by advancements in molecular biology and genetics
- **Gene analysis** is an emerging area that could allow practitioners to predict possible health challenges in an animal's lifetime through a Molecular genetic "risk profile."

i) Environmental DNA/RNA (eDNA/eRNA)

- Environmental DNA (eDNA) and environmental RNA (eRNA) are innovative techniques for detecting DNA and RNA in air, water, and soil samples. This non-invasive method captures nucleic acids released by organisms. This technique aids in disease diagnosis and monitoring in animals. Researchers have reported the use of eDNA and eRNA in biosecurity measures of animal farms.

k) Big data and predictive analytics: Powering proactive health

Animal health care generates vast amounts of data, from vet records to activity logs from wearables. Big data analytics transform this information into actionable insights.

- **Health trend analysis:** By studying data across thousands of animals, we can identify emerging health risks and regional disease patterns.
- **Personalized alerts:** Platforms like IDEXX use data to send customized wellness alerts to clients, nudging them about pet vaccinations, diet changes, or preventive screenings.
- **Farm management software:** Big data help farmers monitor herd performance, detect productivity issues early, and optimize resources like feed and medication.

l) Next-generation sequencing (NGS) technology:

- Next-Generation Sequencing (NGS) is a high-throughput DNA sequencing technology that rapidly sequences millions of DNA fragments simultaneously. It's based on the principle of fragmenting DNA, attaching adapters, amplifying these fragments, and then sequencing

them in parallel. The core concept involves reading the sequence by identifying the fluorescently labeled nucleotides as they are added to the growing DNA strand.

- It is a valuable diagnostic tool used to sequence pathogens to understand their evolution and identification better. It has been successfully applied in disease diagnosis of human, animals and agriculture.

m) Biosensors

- Biosensors have emerged as essential tools in the field of molecular biology and bioanalytics, offering highly sensitive and specific methods for detecting and quantifying a wide range of biomolecules. These devices are valued for their ability to convert a biological response into a detectable signal, directly correlating with the concentration of the target molecule.
- Electrochemical biosensors coated with novel surface chemistry dramatically simplify development of portable diagnostics with potential to detect many disease biomarkers. Biosensors are rapidly gaining ground in animal health. These innovative devices can detect specific molecules associated with diseases, toxins, or environmental changes. They offer a fast and accurate means of diagnosing health issues in animals, enabling early intervention and precise treatment. (fig.1.)
- Biosensors address the critical problem of diagnosing infectious diseases in livestock, where the early and accurate detection of pathogens like *Brucella* and *Toxoplasma gondii* is essential for preventing significant reproductive health issues.

n) CRISPR Technology

- Clustered Regularly Interspaced

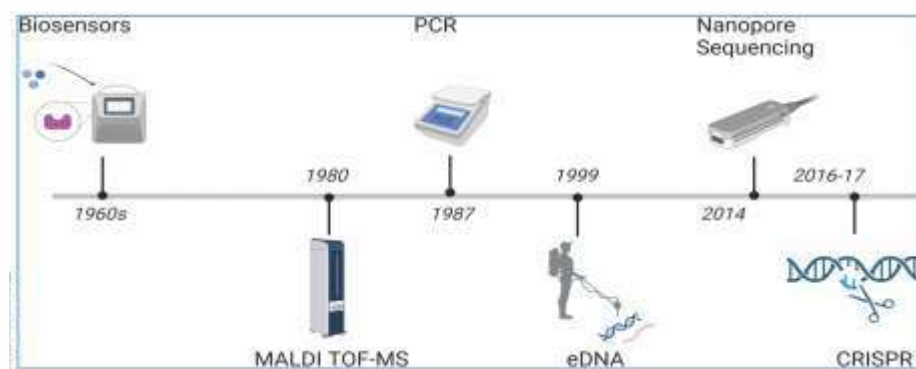


Fig. 1. A chronological overview of disease diagnostic tool development

Short Palindromic Repeats (CRISPR) gene-editing technology can potentially transform how diseases are treated. It could help make significant advances against killer diseases like cancer.

- The CRISPR-Cas system, initially a genetic editing tool, is now being adapted for disease detection in animals. By designing CRISPR-based tests, farmers can rapidly identify diseases with high accuracy, providing an innovative approach to disease management in animal populations.
- CRISPR gene editing and next-generation sequencing (NGS) have transformed clinical and life sciences research. CRISPR permits the selective targeting and editing of specific nucleotide sequences, with a degree of accuracy and ease unachievable just a few years ago. NGS allows for high-throughput, precise and affordable DNA or RNA sequencing.

o) Smart bandages

- A bandage that uses sensors to monitor wound healing has been developed by researchers in the US. It “promotes faster closure of wounds, increases new blood flow to injured tissue, and enhances skin recovery by significantly reducing scar formation”, according to the Stanford University team behind it.

- A thin electronic layer on the bandage has temperature sensors that monitor a wound. If necessary, they can trigger more electrical stimulation to accelerate tissue closure.

p) Blockchain technology: Safeguarding animal health records

- Amid all the sensitive information being exchanged, blockchain technology offers a secure solution.
- No alterations are possible: Blockchain guarantees precision and accuracy in protecting an individual’s health record, including the vaccination and treatment history.
- Visibility into the supply chain: In the case of animal husbandry and food production, blockchain monitors an animal’s life cycle from birth through its life until it’s sold, enhancing food safety and traceability.

The road ahead: A smarter, healthier future

The pace of digital disruption over the past few years has been spectacular, transforming every sector of the economy, including animal production, health and welfare. The fusion of these technologies is not happening in isolation—it’s creating a synergistic ecosystem where AI analyzes IoT data, telemedicine uses big data insights, and

genomics informs personalized care plans.

Imagine this scenario: A farmer receives a mobile alert from a smart collar indicating early symptoms of illness in a cow. An AI diagnostic platform analyzes the data, suggests preventive measures, and schedules a telemedicine consultation—all automatically, in real time. Blockchain secures the treatment record for future reference.

The speed of both the development and application of digital technologies in animal health is increasing exponentially. While it took 150 years for dairy farming to shift from hand milking to mechanised milking, the last three decades alone have seen the introduction of milking robots, wearable sensors and heat detectors to identify the optimum window for cattle breeding.

New digital tools, services and insights are continually uncovering new potential to enhance the key pillars of defending and maintaining good animal health: prediction, prevention, monitoring, diagnosis and treatment. Modern data infrastructure and analytics is allowing knowledge to be aggregated globally and across animals in every region so that:

- Veterinarians facing a rare circumstance or illness can tap into insights gleaned from the experiences of others to better understand treatment options.
- Researchers seeking subtle signs of health changes can use machine learning to analyse endless animal profiles and diagnostics results to find the subtle ‘signal in the noise’ that enables new protocols for prevention.
- Retailers can lean upon digital traceability systems that allow them to see how animals are raised and their produce reaches store shelves, helping them inform

consumers of the safety and sustainability of production.

Furthermore, digital technologies are allowing for a level of individualized care never before achieved in animal health.

- Digital technologies hold immense promise to strengthen prevention, productivity, One Health, and overall animal care. It begins with the three primary areas of innovation – predictive, monitoring and diagnostics technologies.
- The digitalisation of diagnostics has provided more, better and earlier data about the signs and symptoms of ill-health, contributing to a greater understanding about how health conditions develop in animals and

how to predict, prevent and treat them.

- Digital monitoring provides a stronger defence against the spread of diseases within a group of animals, and between animals and people.
- From microphone systems that identify fluctuations in poultry vocalization to computerised patient records and activity trackers for pets that help owners care for their pets in new ways – technology has relieved the burden of observation and filled the communications gap between animal and human.
- This data is increasingly being aggregated to build veterinary intelligence systems that can predict changes in an animal's

health state before it even occurs, allowing for preventative measures and custom health plans.

- Tools already exist that can amass and cross-reference animal health data and alert a farmer or veterinarian to an emerging issue based on signs in an animal's behaviour, biological markers or diagnostics results.

Former and founder VC, KVAFSU, Former Director, IAH&VB, Bangalore.
Former Prof and Head, Veterinary Pathology, Veterinary College, UAS, Bangalore

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ASSOCIATION OF LIVESTOCK SECTOR

2nd Announcement

CLFMA 59th AGM & 67th NATIONAL SYMPOSIUM 2026

Dear Sir / Madam,

We are pleased to inform you that, the 59th Annual General Meeting (AGM) and 67th National Symposium 2026 will be held on September 11 & 12, 2026 at “The Leela Mumbai”, Sahar, Near Mumbai International Airport, Andheri East, Mumbai.

The theme of the symposium is **"Animal Agriculture: The Backbone of Sustainable Development"**

Please find attached Delegate Registration Form.

Our bank details are as follows.

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If your organization has more than two delegates, you may use photocopies of the delegate registration form.

Meanwhile please reserve your dates for AGM and National Symposium and reply to admin@clfma.org for any query related to the matter above.

With warm regards,

Divya Kumar Gulati
Chairman



DELEGATE REGISTRATION FORM

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Date :

Sub: CLFMA AGM & National Symposium 2026
"Animal Agriculture: The Backbone of Sustainable Development"

11 & 12 September 2026 at "The Leela Mumbai", Sahar, Near Mumbai International Airport, Andheri East, Mumbai.

Dear Sir / Madam,

I / We wish to participate in the above Symposium as delegate.

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Mr. / Dr. _____

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