

Livestock & Feed Trends



VOLUME - 23 • NUMBER - 4 • JANUARY - MARCH 2026



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From the Chairman's Desk.....

Dear Friends,

Warm greetings to you all!

The quarter January to March 2026 has been both dynamic and productive for CLFMA OF INDIA, marked by active engagement with policymakers, industry stakeholders, and global platforms, reinforcing our commitment to strengthening 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 January to March 2026**, presented under “**CLFMA Activity Updates**”:

We began the year with a significant interaction at the policy level, where CLFMA Executive Director, Col.Vinay Kumar, had the privilege of meeting the Hon'ble Minister of State for Fisheries, Animal Husbandry and Dairying. This interaction reflected CLFMA's continued efforts to collaborate closely with the Government of India and contribute to policy dialogue aimed at advancing the livestock sector and feed industry, which remain critical to national food security and farmer livelihoods.

In January, CLFMA co-hosted a Roundtable in Kolkata in partnership with the West Bengal Poultry Federation and U.S. Grains & Bio-Products Council. The discussion focused on future ingredient supplies for the Indian feed industry, highlighting the importance of alternative feed resources such as U.S. sorghum and the need for efficiency-driven solutions for feed manufacturers.

Sustainability remained a key theme throughout the quarter. CLFMA actively participated in discussions on fish waste utilization, where the focus was on converting waste into value-added products such as fish meal, fish oil, and bio-based solutions. The deliberations emphasized the importance of circular economy approaches, innovation, and policy support to unlock the full potential of underutilized resources.

Our engagement with ICAR institutions during the Stakeholders' Consultation on “Maize for Industrial Uses – Envisioned Viksit Bharat @2047” highlighted the growing importance of maize as a strategic crop for feed,



food, and biofuel sectors. The discussions underscored the need for integrated policy support, improved productivity, and a robust supply chain to meet the rising demand across industries.

CLFMA also continued its active role in regulatory and standardization initiatives. Participation in the BIS Annual Programme for Standardization meeting and consultations on antibiotic residues with FSSAI reflects our commitment to ensuring quality, traceability, and global competitiveness of the Indian feed sector. We have also made key representations to the Government on critical issues such as DORB exports, soybean meal availability, and the proposed Feed Act 2026, advocating for policies that support industry growth and sustainability.

February month witnessed strong industry engagement through participation in global and national platforms. The World Seafood Congress 2026 in Chennai was a landmark event, where CLFMA showcased its role in supporting the seafood and aquaculture feed sector. Our participation in the Kolkata International Poultry Fair and various stakeholder consultations further strengthened our outreach and collaboration within the industry.

Knowledge-sharing and capacity-building remained central to our efforts. The Poultry Seminar in Coimbatore and the National Dairy Seminar in Kerala provided

valuable platforms for discussing disease management, dairy nutrition, and modern feeding practices. These initiatives reflect our ongoing commitment to bridging the gap between research and industry practices.

In March, CLFMA actively participated in key national dialogues on agri-exports, trade opportunities, and protein security. Discussions on Free Trade Agreements and global market access highlighted the need for strengthening India's export ecosystem while ensuring farmer welfare. At the same time, roundtable dialogues on poultry's role in nutrition security reinforced the sector's importance in addressing India's protein requirements.

Our participation in the Maize & Millet Summit 2026 further emphasized the challenges related to feed ingredient availability and pricing, while also highlighting the need for innovative solutions and policy interventions to ensure sectoral stability.

Additionally, platforms such as DDGS Market Connect 2026 provided an opportunity to explore alternative feed ingredients and promote their effective utilization

in animal nutrition, aligning with our focus on sustainability and cost efficiency.

As we conclude this quarter, it is evident that collaboration, innovation, and policy advocacy will continue to play a crucial role in shaping the future of the livestock and feed industry. CLFMA remains committed to working alongside government bodies, industry partners, and research institutions to drive growth, enhance productivity, and ensure sustainability across the sector.

We look forward to building on this momentum in the coming months, with renewed focus on strengthening the feed industry's contribution to India's agricultural and economic development.

For **CLFMA OF INDIA**,



Mr. Divya Kumar Gulati
Chairman





07CHAIRMAN'S DESK

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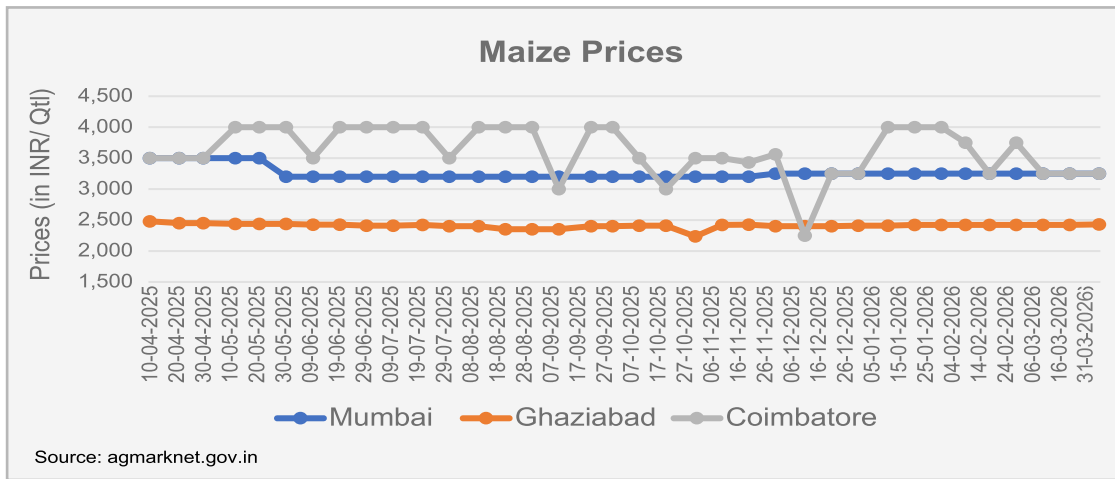
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Commodity Updates

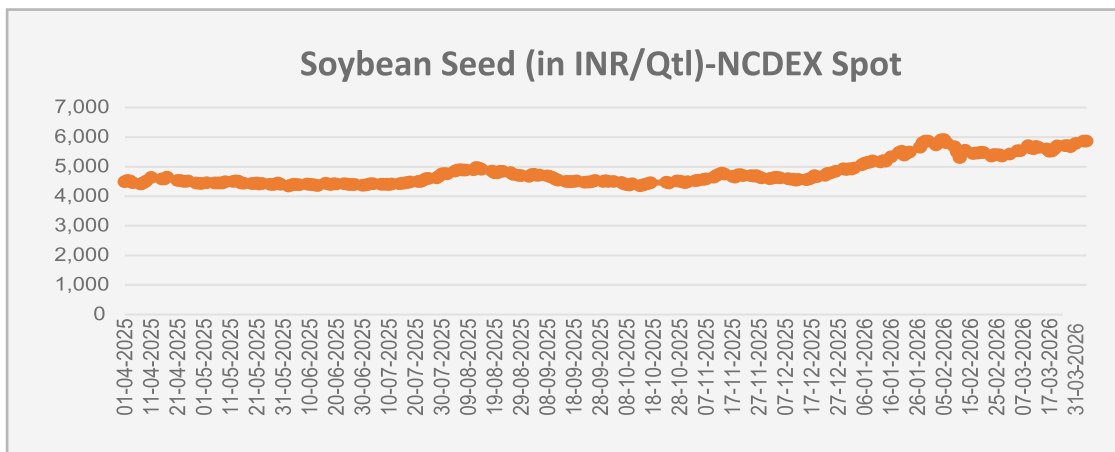
1. Domestic Prices

I. Maize



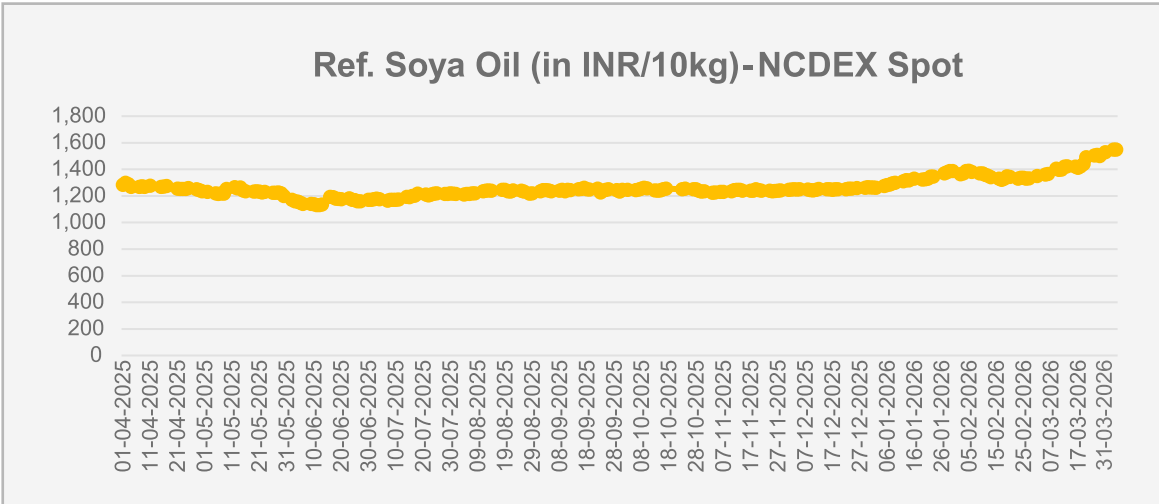
Maize Prices (INR/Quintal)		
City	31/03/2026	28/02/2026
Mumbai	3,250	3,250
Ghaziabad	2,420	2,420
Coimbatore	3,250	3,750

II. Soybean

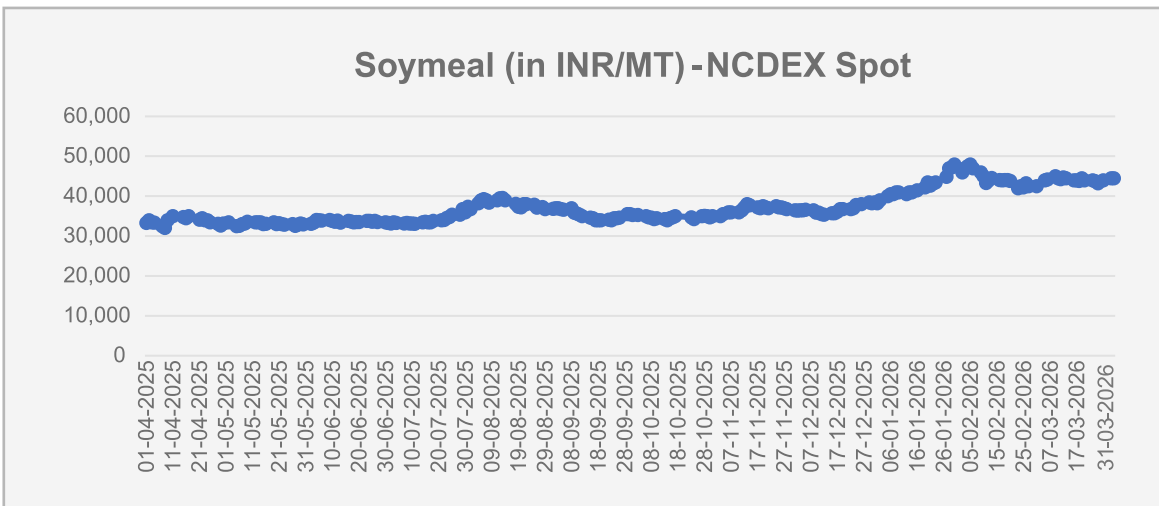


Soybean Complex Prices-NCDEX Spot		
Commodity (Unit)	31/03/2026	28/02/2026
Soybean Seed (in INR/Qtl)	5,861	5,359
Ref. Soya Oil (in INR/10kg)	1,549	1,331
Soymeal (in INR/MT)	44,500	42,500

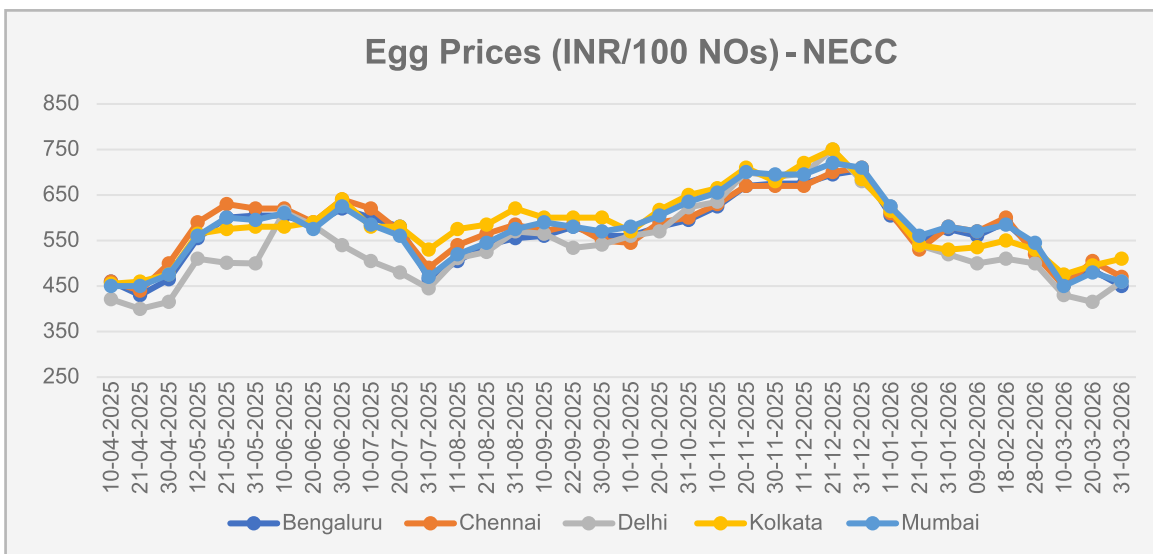
Ref Soya Oil



Soymeal



III. Egg Rates



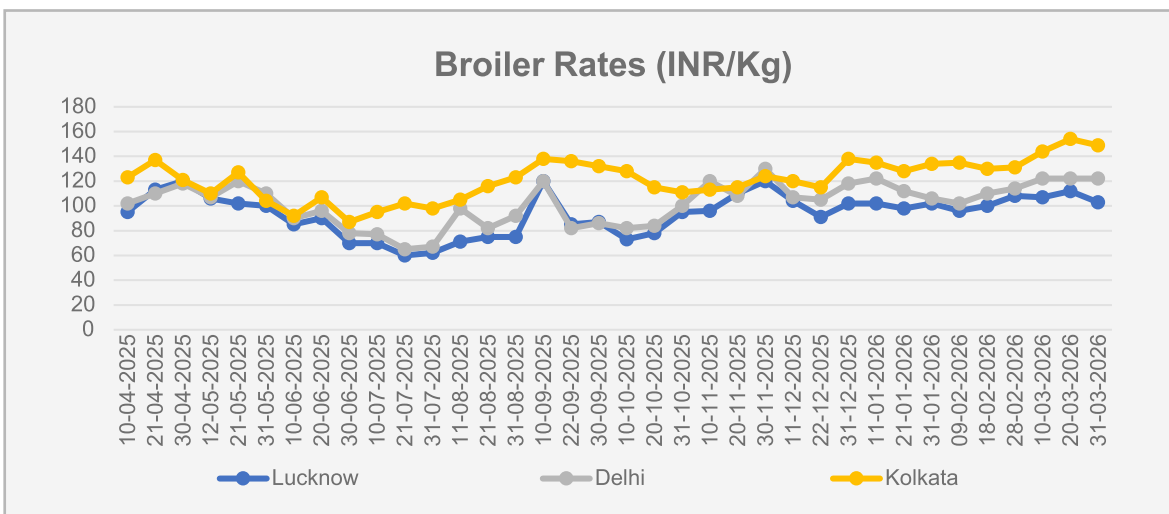
EGG PRICES (INR/100 NOs)		
Name of Zone	31/03/2026	28/02/2026
NECC Prices		
Ahmedabad	450	515
Ajmer	430	450
Barwala	430	448
Bengaluru (CC)	450	530
Brahmapur (OD)	450	480
Chennai (CC)	470	520
Chittoor	463	513
Delhi (CC)	460	500
E.Godavari	425	480
Hospet	390	470
Hyderabad	415	470
Jabalpur	425	490
Kolkata (WB)	510	530
Ludhiana	422	477
Mumbai (CC)	460	545
Mysuru	455	530
Namakkal	405	480
Pune	455	545
Raipur	425	480
Surat	450	525
Vijayawada	440	500
Vizag	430	485
W.Godavari	425	480
Warangal	417	472

III. Egg Rates

EGG PRICES (INR/100 NOs)		
Name of Zone	31/03/2026	28/02/2026
Prevailing Prices		
Allahabad (CC)	476	524
Bhopal	430	480
Indore (CC)	440	490
Kanpur (CC)	462	514
Lucknow (CC)	467	538
Muzaffarpur (CC)	490	510
Nagpur	440	510
Patna	490	510
Ranchi (CC)	467	528
Varanasi (CC)	477	507

Source: NECC

IV. Broiler Rates



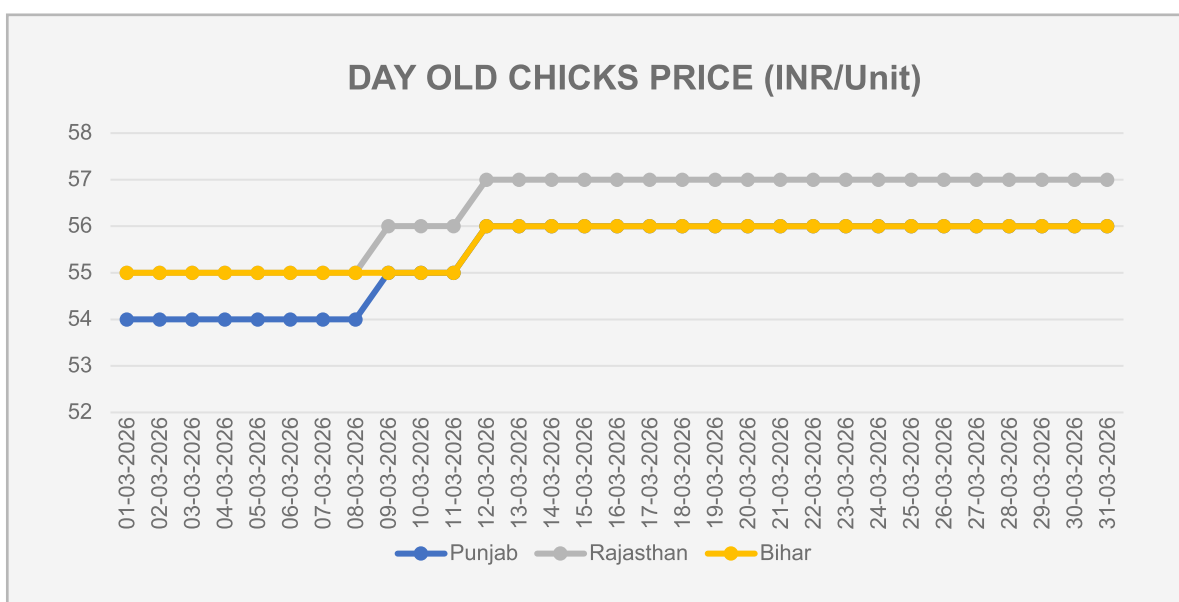
BROILER RATES (INR/Kg)		
Location	31/03/2026	28/02/2026
Delhi	122	114
Punjab	104	108
Raipur	110	112
Pune	125	119
Bengaluru	102	119
Hyderabad	125	140
Guwahati	118	120
Kolkata	149	131
Bihar	115	120
Madhya Pradesh	104	125
Lucknow	103	108

Source: SRP (Wholesale Rates)

V. Day old Chicks Price

DAY OLD CHICKS PRICE (INR/Unit)		
State	31/03/2026	28/02/2026
Punjab	56	54
Dehradun	57	55
Haryana	56	54
Himachal Pradesh	57	55
Rajasthan	57	55
Jammu	58	56
Andhra Pradesh	53	53
Uttar Pradesh	56	55
Madhya Pradesh	55	55
Telangana	53	53
Bihar	56	55
Jharkhand	56	55
Gujarat	55	55

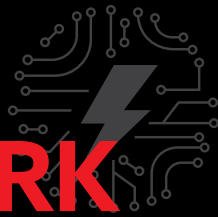
Source: Poultry India TV/ SRP



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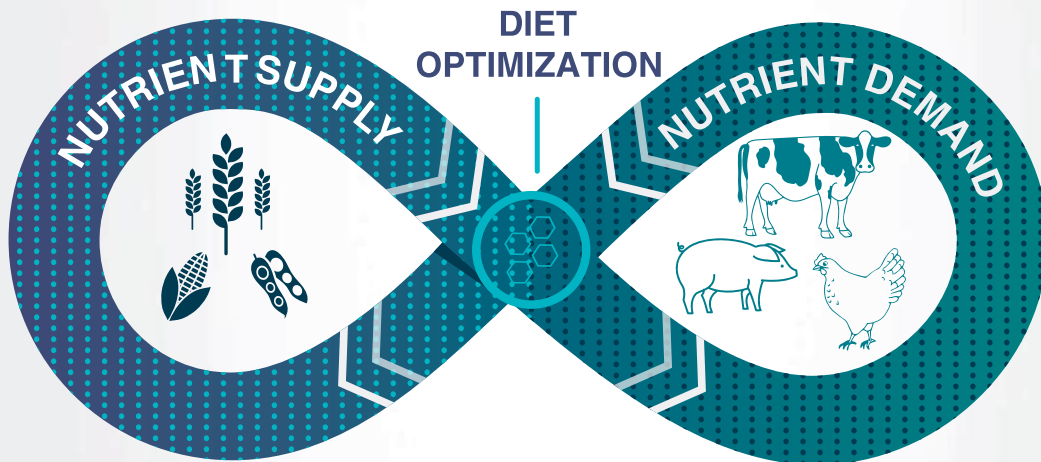
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million samples tested per year

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VI. Fish Prices

Fish Prices Average Price (INR/Quintal)		
Fish Type	31/03/2026	28/02/2026
Bata Putti	7,500	8,000
Black Dom	14,000	15,000
Blue Dom	16,000	16,000
Chilwa	13,000	12,000
Halwa	31,500	30,500
Hilsa	55,000	60,000
Katla (Small)	12,000	11,000
Malli (Big)	22,500	22,000
Malli (Small)	22,000	15,500
Pangass	8,000	8,000
Katla (Big)	17,000	17,000
Singhra (Big)	30,000	34,500
Singhra (Small)	20,000	29,500
Surmali (Small)	35,000	51,000
Surmai (Big)	47,500	50,000
Sol	31,000	31,000
Soli	20,000	20,000
White Dom	16,000	16,000
Rahu (Andhra)	14,000	12,500
Zinga (Zambo-A)	55,000	55,000
Zinga (Zambo-B)	50,000	50,500
Zinga (Zambo-C)	35,000	35,000

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

2. Global Commodity Prices

Commodity (Unit)	PRICE (31/03/2026)
Milk (USD/CWT)	16.06
Rapeseed (Euro/Ton)	507.52
Soybean Meal (USD/Ton)	315.10
Soybean Oil (USD/lb)	0.68
Live Cattle (USD/Lbs)	2.43
Poultry (USD/Kgs)*	1.38
Eggs US (USD/Dozen)	0.77

Source:tradingeconomics; markets.businessinsider

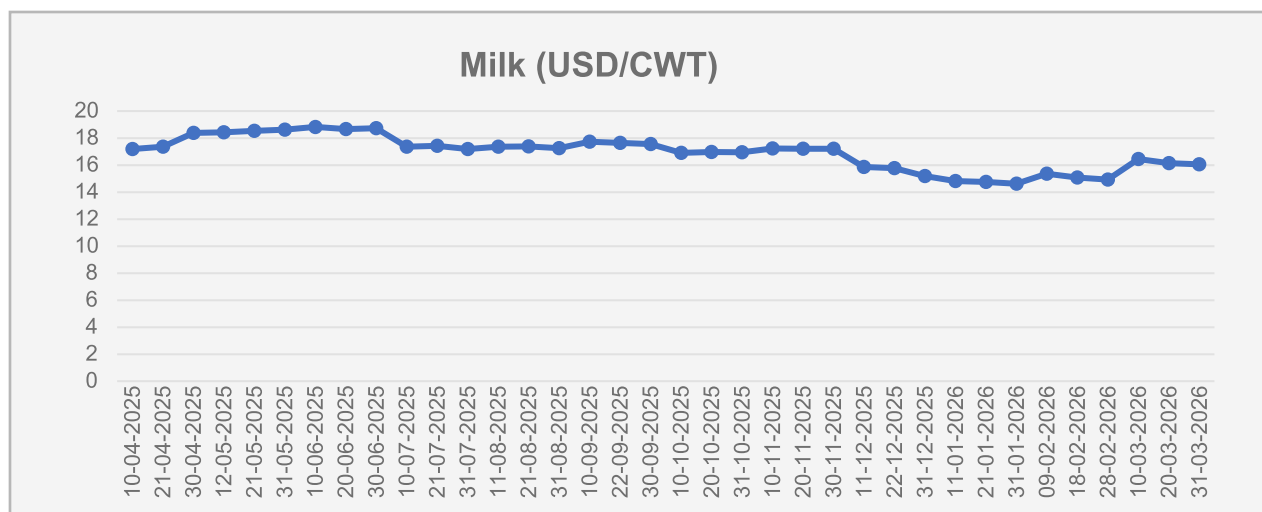
USD: United States Dollar

CWT: Short Hundredweight

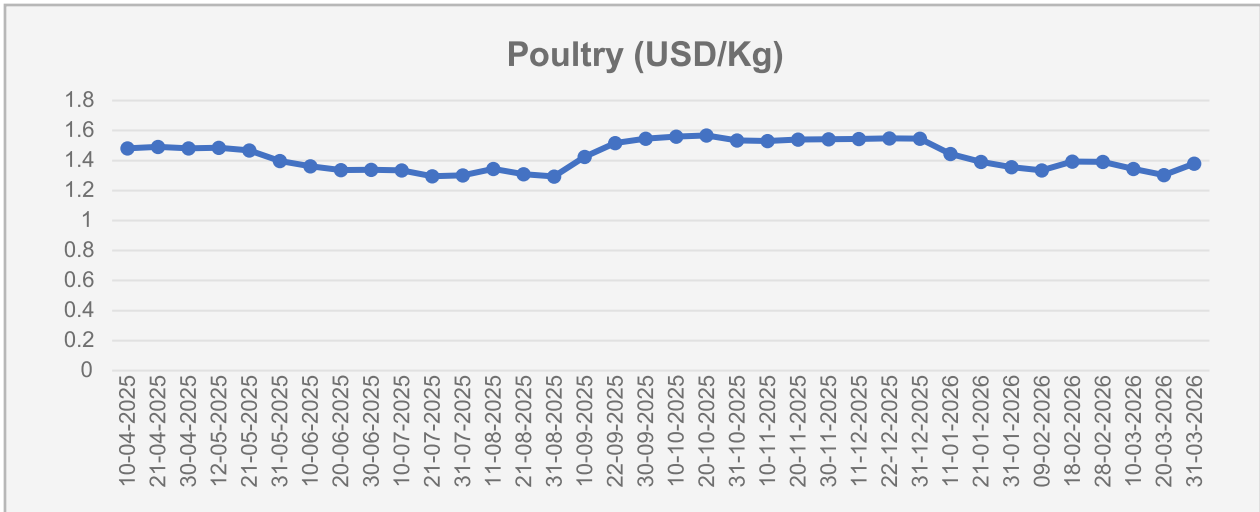
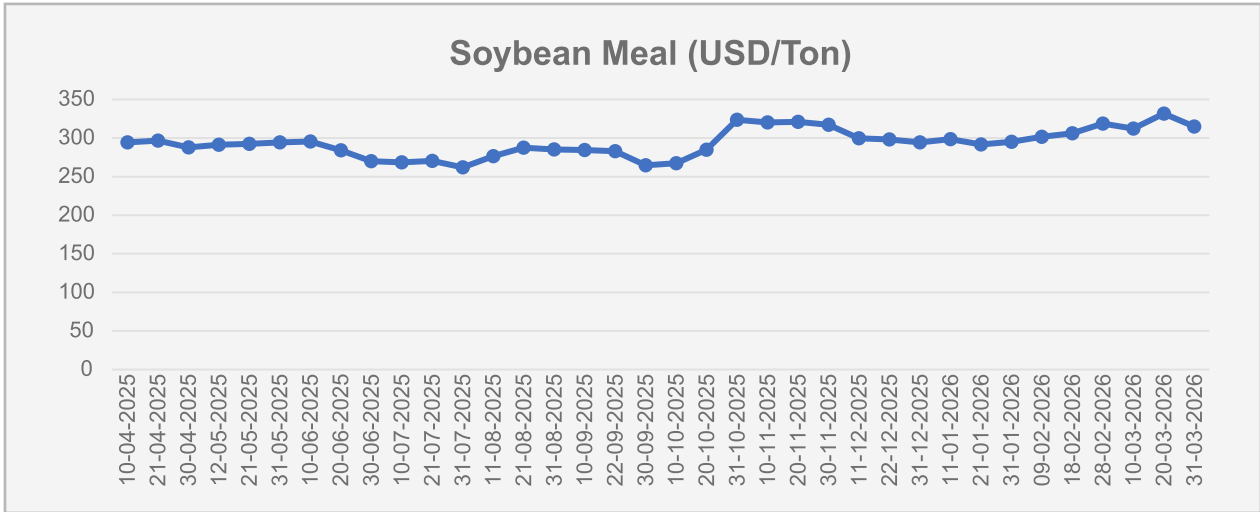
Lbs: Pounds

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 conversion rate.

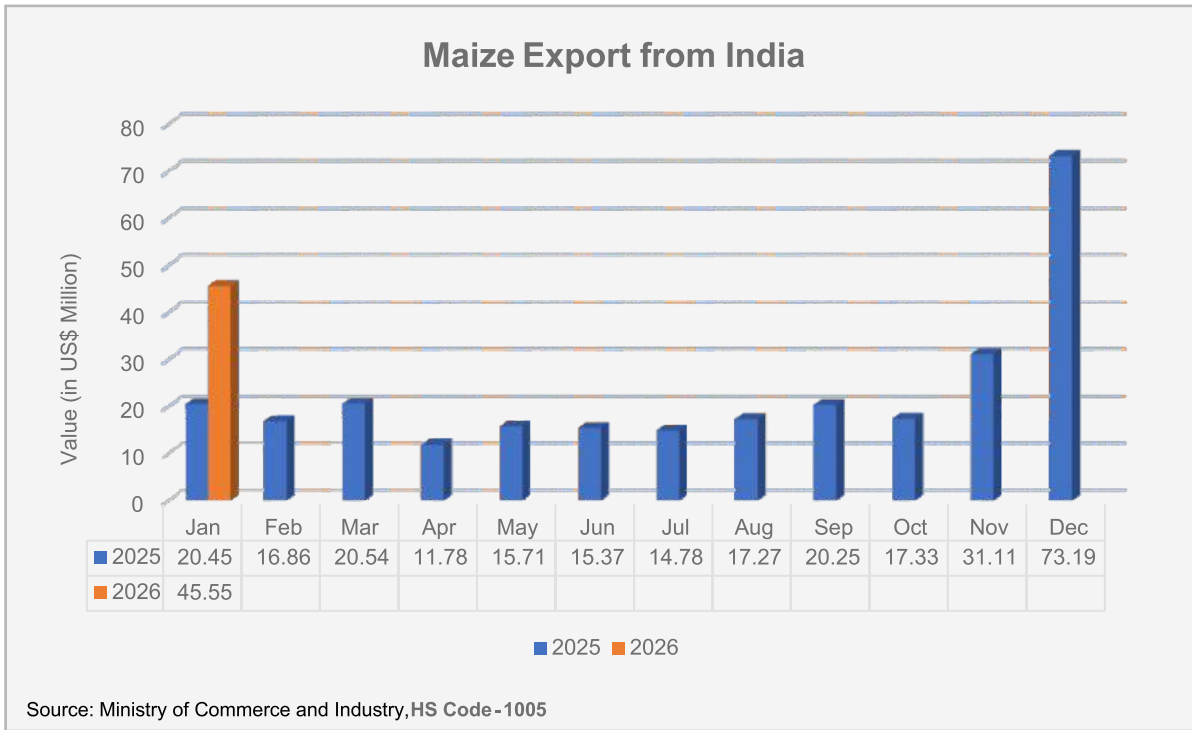


2. Global Commodity Prices

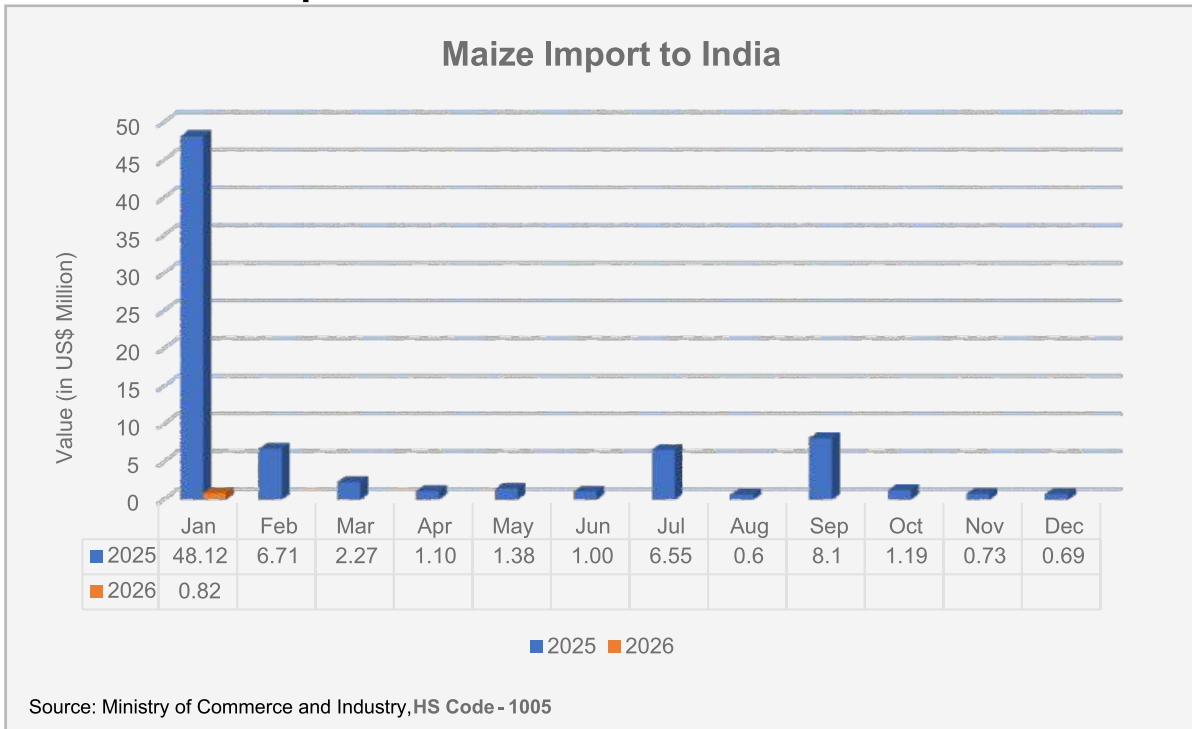


3. Trade Details

India: Maize Export

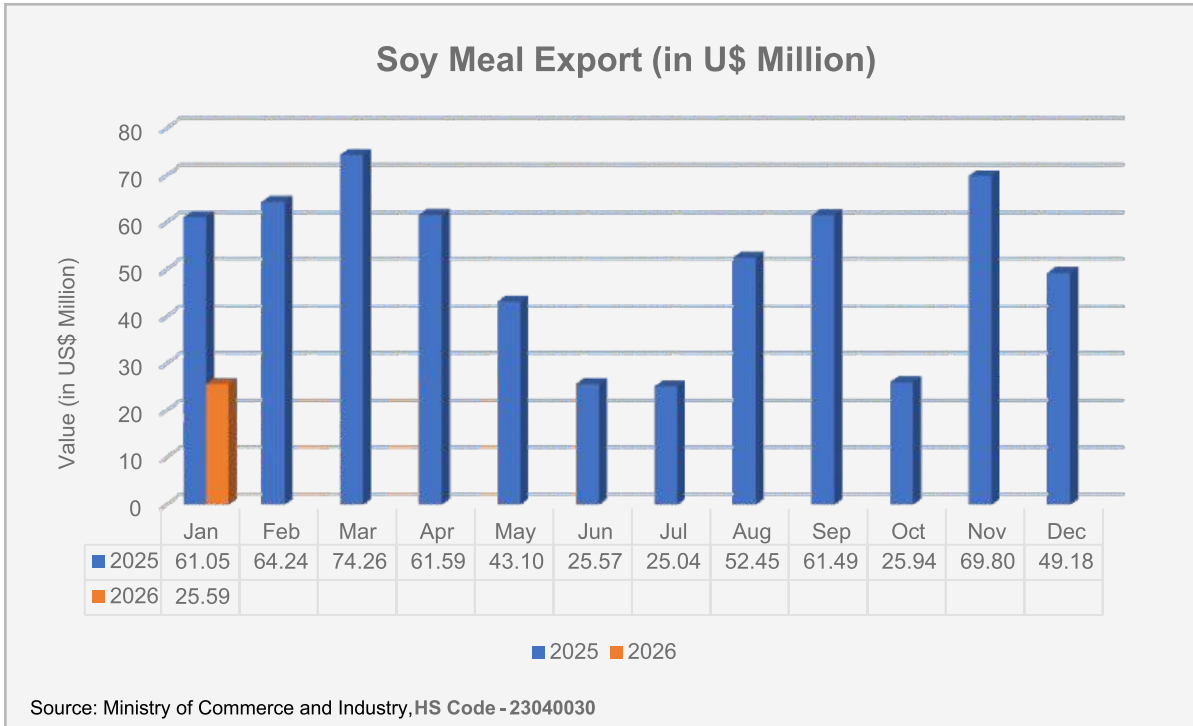


India: Maize Import

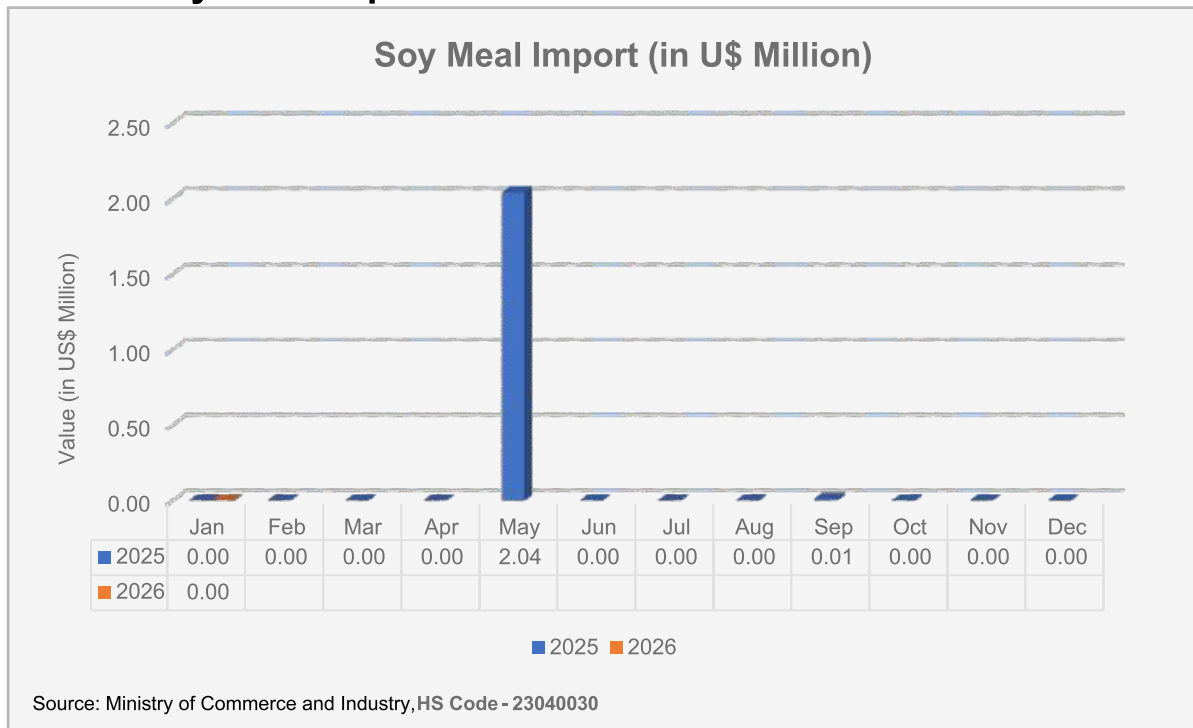


Note: This Data is sourced from the Ministry of Commerce and Industry, which was last updated in January.

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 January.

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,
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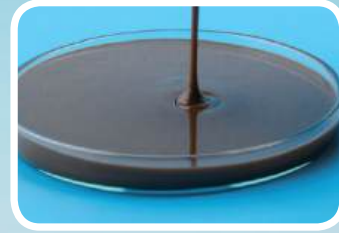
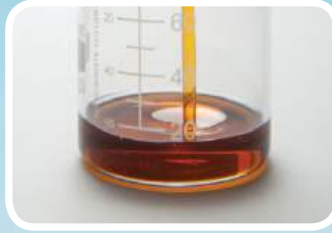
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CLFMA ACTIVITY UPDATES

CLFMA OF INDIA's Executive Director Col. Vinay Kumar had a courtesy Meeting with Hon'ble Minister of State of Fisheries, Animal Husbandry and Dairying, Prof. S. P. Singh Baghel, GOI:

On 08 January 2026, it was a privilege to extend warm greetings to Prof. S. P. Singh Baghel on behalf of Mr. Divya Kumar Gulati, Chairman, CLFMA OF INDIA, along with the Office Bearers and the entire Managing Committee of CLFMA OF INDIA. During the interaction, best wishes were conveyed to the Hon'ble Minister for his continued leadership and efforts in strengthening India's livestock, poultry, and dairy sectors.

On behalf of CLFMA OF INDIA, appreciation was expressed for the Ministry's support towards the development of the feed industry, which plays a critical role in improving livestock productivity, ensuring food security, and supporting the livelihoods of millions of farmers across the country.

The interaction reflected CLFMA OF INDIA's continued commitment to working closely with policymakers and stakeholders to promote innovation, sustainability, and growth in India's livestock and animal feed sector.



Kolkata Roundtable discussion on ingredient supplies for the future of the Indian Feed industry on 16th January, 2026 at Pala III, ITC Sonar, Royal Bengal, 1, JBS Haldane Ave, Tangra, Kolkata, West Bengal 700105:

CLFMA of India, in partnership with West Bengal Poultry Federation and U.S. Grains & Bio-Products Council hosted a roundtable discussion on ingredient supplies for the future of the Indian feed industry. The session featured comments from U.S. farmers and agricultural stakeholders as well as an overview of the Indian poultry sector from WBPF.

Mr. Divya Kumar Gulati, Chairman, CLFMA of India set the context for the roundtable, highlighting the rapid growth of the feed industry and the need for multiple tools for feed millers and producers for maximum efficiency. The industry was curious to learn more



about U.S. sorghum, a non-GM ingredient that can be used in a similar manner to corn in animal feed rations.

Webex Meeting dated 19th January, 2026 on "Discussion on the Potential of Fish Waste Utilization" attended by CLFMA Hon. Secretary, Mr. Nissar F. Mohammed:

A meeting on "Discussion on the Potential of Fish Waste Utilization" was held on 19th January 2026 from 11:00 AM to 1:00 PM through Webex, under the chairmanship of Shri Sagar Mehra, Joint Secretary (Inland Fisheries), Department of Fisheries, Government of India, New Delhi, to discuss the potential of fish waste utilization.

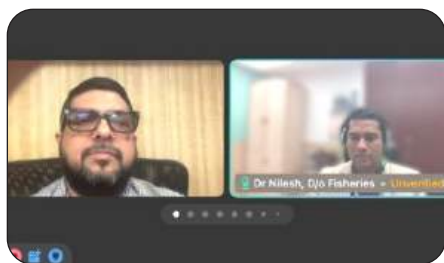
The meeting focused on exploring sustainable and economically viable pathways for the utilization of fish waste generated from fisheries and fish processing activities. Participants deliberated on various value-addition

opportunities, such as fish meal, fish oil, protein hydrolysates, organic manure, and emerging technologies, including insect-based bioconversion. Key challenges related to infrastructure, awareness, and logistics were discussed, along with the need for pilot initiatives and policy support.

From CLFMA OF INDIA, Mr. Nissar F. Mohammed, Hon. Secretary, CLFMA OF INDIA, attended the meeting. He discussed the conversion of waste into profit, particularly in the fish industry, by utilizing stick water from fish meal production to produce fish soluble paste, as well as the potential of chitin and chitosan derived from shrimp waste.

More than 50 participants attended the meeting. Participants agreed on the need for coordinated efforts among government, industry, and research institutions to take this initiative forward.

The meeting concluded with a consensus on promoting a circular economy approach in the fisheries sector through collaborative efforts, technological interventions, environmental protection, structured implementation strategies, and improved economic returns.



ICAR-Indian Institute of Maize Research (IIMR), Ludhiana and ICAR-National Institute of Agricultural Economics and Policy Research (NIAP) organized a Stakeholders' Consultation and Brainstorming Session on 29th January 2026:

ICAR-Indian Institute of Maize Research (IIMR), Ludhiana and ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), was jointly organized a Stakeholders' Consultation and Brainstorming Session on the theme "Maize for Industrial Uses - Envisioned Viksit Bharat @2047" on 29th January 2026, from 10:00 am to 2:00 pm, at ICAR-National Institute of Agricultural Policy Research (NIAP), New Delhi, in hybrid mode.

The consultation aimed to deliberate on emerging opportunities, key challenges, and policy pathways for strengthening maize-based industrial value chains in India in alignment with the national vision of *Viksit Bharat @2047*.

The session witnessed focused brainstorming discussions among a wide spectrum of stakeholders representing the ethanol and biofuel sector, poultry and livestock feed industry, starch and processing industry, farm machinery, seed and pesticide industries, along with officials from concerned ministries, policymakers, and scientists from ICAR institutes.

Deliberations highlighted the growing importance of maize as a strategic industrial crop, particularly for ethanol blending, animal feed, food processing, and value-added products. Key issues discussed included assured maize availability, productivity enhancement, price volatility, competing sectoral demands, infrastructure and logistics gaps, and the need for farmer-centric and industry-friendly policy support.

The meeting emphasized the importance of integrated policy planning, improved varietal development, mechanization, sustainable production practices, and stronger public-private partnerships to ensure a resilient and scalable maize ecosystem capable of meeting future industrial and food security needs.

The consultation concluded with a collective consensus on the need for coordinated efforts among research institutions, industry stakeholders, and government agencies to unlock the full potential of maize as a growth engine for India's agri-industrial economy.

The programme witnessed the participation of more than 45 delegates (physical and virtual modes) including scientists of ICAR and CIMMYT, policymakers (FICCI), industry leaders and representatives from ethanol (GEMA, UPDA), feed (CLFMA), silage, poultry (PFI), starch, food processing, seed, and agri-input (FSII, Corteva, Bayer, Advanta, CP Seeds) sectors. The deliberations focused on enhancing maize-based industrial utilization, sustainability, bio-innovation, and policy support, aligned with the national vision of *Viksit Bharat @2047*. From CLFMA OF INDIA Ms. Shilpa Utekar, Admin Manager attended the meeting. Mr. Raghavan Sampathkumar, Executive Director of FSII said Value Chain approach through FPOs from seed to feed is essential for ensuring raw material for fast growing livestock sector.





BIS Meeting attended by Executive Director, Col. Vinay Kumar, CLFMA OF INDIA on 29th January, 2026:

The meeting for the preparation of the Annual Programme for Standardization (APS) 2026–2027, scheduled on 29th January, 2026 at 10:30 a.m. at Bureau of Indian Standards (BIS), New Delhi, was attended by Col. Vinay Kumar, Executive Director, CLFMA OF INDIA, representing the Association.

Ms. Neha Yadav, Scientist–E (Director), BIS, New Delhi, briefed the participants on various standardization issues and the initiatives being undertaken by BIS to address them. During the meeting, Col. Vinay Kumar highlighted the concerns of the livestock sector, particularly emphasizing the need for standardization related to traceability to meet evolving domestic requirements and enhance export quality standards.

The Committee appreciated the inputs shared and assured that capacity-building sessions would be conducted to address traceability-related standardization issues.

The meeting was attended by over 60 participants, with 29 participants attending in person and more than 30 joining virtually. Overall, the meeting was productive and successful for CLFMA OF INDIA, with BIS acknowledging and appreciating the valuable role of industry associations in providing inputs for the APS 2026–2027.

CLFMA OF INDIA wrote a letter to GOI on 2nd February, 2026:

CLFMA OF INDIA wrote a letter to the

Government of India on 2nd February, 2026. The letter was addressed to Dr. Muthukumarasamy B., Joint Secretary (NLM), Department of Animal Husbandry & Dairying, Government of India, on the subject “CLFMA Representation seeking Government Intervention to impose an immediate ban on the export of DORB.”

Webex Meeting with Seafood Exporters of Karnataka and Goa on 04th February 2026 at 11:30 am:

A virtual meeting with seafood exporters from Karnataka and Goa was organized by the Marine Products Export Development Authority (MPEDA) Headquarters on 04th February 2026 at 11:30 AM through a Webex video conference. The meeting brought together key stakeholders from the seafood export sector to deliberate on important policy developments, industry concerns, and upcoming initiatives aimed at strengthening India's seafood exports.

Mr. Nissar F. Mohammed, Hon. Secretary, CLFMA OF INDIA, attended the meeting and represented the perspectives of the feed manufacturing sector, particularly with respect to fish meal and fish oil production, which are critical inputs for aquaculture feed.

The meeting focused on several key agenda items. One of the primary discussions revolved around the capacity fixation of Fish Meal and Fish Oil plants under the new MPEDA guidelines, where exporters and industry representatives shared their views on implementation and its potential implications for the sector.

Participants also deliberated on the India–European Union Free Trade Agreement (India–EU FTA) and its possible impact on seafood exports, including opportunities that may arise for Indian exporters in the European market.

Another important topic was the impact of the Union Budget on Indian seafood exports, where stakeholders discussed policy measures, incentives,

and challenges that could influence export competitiveness. The meeting also highlighted the importance of participation in international trade fairs to enhance market visibility and promote Indian seafood globally.

MPEDA officials further provided insights into various MPEDA schemes aimed at promoting value addition in seafood processing, encouraging exporters to leverage these initiatives to enhance product quality and diversification.

In addition, discussions were held on the upcoming Seafood Expo Bharath 2026, with an emphasis on industry participation and the role the event can play in showcasing India's seafood sector to domestic and international buyers.

The meeting served as an important platform for dialogue between MPEDA and seafood exporters, enabling stakeholders to exchange views on regulatory developments, trade opportunities, and strategies to strengthen the growth and global competitiveness of India's seafood industry.

CLFMA OF INDIA wrote a letter to GOI on 6th February, 2026:

CLFMA OF INDIA wrote a letter dated 6th February, 2026 to Shri. Rajiv Ranjan Singh, Hon'ble Minister of Fisheries, Animal Husbandry and Dairying, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi on the subject Urgent Representation on Soybean Meal Availability and Price Escalation Impacting Animal Agriculture.



CEAH Podcast 34 - Mr. Divya Gulati Chairman on 6th February, 2026:

It was a proud moment for CLFMA OF INDIA that in Episode 34 of the CEAH Academy Podcast, Divya Kumar Gulati, Chairman of the Compound Livestock Feed Manufacturers Association (CLFMA), shared insights into the legacy and vision of the organization. He spoke about CLFMA's rich history, highlighting its association with the livestock feed sector since 1967. He elaborated on the organization's core mandates, including coordinating efforts across the livestock sector, conducting survey reports, and managing representative data with authentic sources—particularly on key commodities such as corn and soybean. He also emphasized CLFMA's large-scale awareness campaigns focused on quality standards, production practices, and transparent price information within the commodity ecosystem. Addressing the youth, he delivered a strong message encouraging greater participation in the livestock sector. He underlined the sector's immense growth potential, stating that with collective effort and innovation, it has the capacity to expand from a ₹20 lakh crore industry to a ₹40 lakh crore sector in the coming years.



The World Seafood Congress (WSC) at Chennai Trade Center from 9th-11th February 2026:

The World Seafood Congress (WSC), held biennially, brought together global seafood industry leaders to showcase the latest advancements and address critical issues such as sustainability and ocean health. Organised by the International Association of Fish Inspectors (IAFI), an international NGO recognised by the United Nations, the Congress continued its legacy of setting new benchmarks for the industry and fostering international collaboration. Over the years, countries including the USA, Canada, the UK, Iceland, Malaysia, and Portugal had hosted the event, and in 2026, India proudly hosted WSC for the first time—marking a significant milestone for the country's rapidly growing seafood sector. The event was organised by PDA Ventures, a Bangalore-based trade show and conference organizer, which successfully delivered a world-class platform for global engagement.

WSC 2026 focused on critical themes shaping the future of seafood, including sustainability, innovation, seafood safety, and global trade. The Congress explored technological advancements, sustainable production practices, and emerging market challenges, offering

valuable insights and strategic direction to participants from across the world. India's role as host underscored its importance as a leading seafood producer and exporter, while providing an opportunity to showcase its strengths and commitment to responsible growth.

Shri. Sagar Mehra, Joint Secretary (Inland Fisheries), Department of Fisheries, Government of India, visited the exhibition on Day 3 that is on 11th February, 2026 and interacted with exhibitors including CLFMA as well, industry leaders, and aquaculture stakeholders. During his visit, he reviewed innovative technologies, sustainable aquaculture practices and export-oriented initiatives being showcased at the Expo, appreciating the sector's efforts towards responsible growth and global competitiveness.

Shri. Tarun Sridhar, IAS (Retd.), Director General of ICFA (Indian Chamber of Food and Agriculture) and Chairman, CARD, and former Secretary of Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, was present at the inaugural event of the World Seafood Congress. He appreciated the activities of CLFMA OF INDIA towards the upliftment of the Indian livestock sector.

CLFMA OF INDIA participated actively in the Congress with a dedicated stall number B209, which received an encouraging response from both domestic and international delegates. From CLFMA OF INDIA Executive Director, Col. Vinay Kumar and Mr. Dinesh Ambavkar, Office Assistant along with CLFMA Hon. Secretary, Mr. Nissar F. Mohammed also attended the World Seafood Congress. The stall served as an effective platform to highlight CLFMA's role in supporting the feed and allied sectors of the seafood industry, facilitating meaningful interactions and strengthening industry connections. WSC 2026 concluded as a landmark

event, reinforcing global cooperation and highlighting India's growing leadership in the seafood ecosystem. Almost 65 visitors visited CLFMA Stall.



CLFMA OF INDIA shared a message on 11th February 2026 from its Hon'ble Chairman Mr. Divya Kumar Gulati for its inclusion in the forthcoming publication "Poultry in India - Edition 2026":

CLFMA OF INDIA shared a message from its Hon'ble Chairman Mr. Divya Kumar Gulati for its inclusion in the forthcoming publication "Poultry in India - Edition 2026" being brought out by White Wing Office. Considering the importance of such industry reference guides in disseminating knowledge

and strengthening connections across the poultry sector, CLFMA appreciates the initiative taken by the publishers. The Association is glad to extend its support to this publication and hopes that the directory will serve as a valuable resource for stakeholders across the poultry and allied industries.

12th Kolkata International Poultry Fair, 2026 (11th - 13th February, 2026)

The Kolkata International Poultry Fair 2026 was held from 11th to 13th February, 2026 at the Biswa Bangla Exhibition Centre, Kolkata. The exhibition covered a wide range of sectors including layer poultry, broiler poultry, breeders, hatcheries, feed, veterinary products, chicks, feed commission agents, feed ingredients, eggs, poultry medicines and feed supplements, poultry health, integrators, poultry farming equipment, reject gunny bags, poultry manure, and poultry packaging materials.

The Kolkata International Poultry Fair is one of the premier poultry exhibitions in India, showcasing the latest advancements in the poultry industry. The event attracted exhibitors and visitors from across the country and abroad, providing an excellent platform for networking, knowledge exchange, and the exploration of innovative technologies. Held annually in the vibrant city of Kolkata, the fair brought together farmers, suppliers, industry experts, and stakeholders, creating valuable opportunities to discuss emerging trends, challenges, and growth prospects in the evolving poultry sector.

Mr. Divya Kumar Gulati, Chairman of CLFMA OF INDIA, attended the NOVACON inaugural programme, where Mr. Swapan Debnath, Honourable Minister of Animal Resources Development, Government of West Bengal, was the Chief Guest, along with several distinguished

dignitaries and representatives of leading industry associations.

The event was hosted by the West Bengal Poultry Federation and featured insightful discussions on the future of the poultry and livestock sectors, sustainability, and industry growth. Special appreciation goes to Mr. Madan Mohan Maity, President of the West Bengal Poultry Federation, for his leadership and the seamless organization of the event.



A Meeting of the High-Level Committee constituted for drafting the National Animal Feed Act was held on 13th February, 2026 at 10:00 AM in hybrid mode under the

Chairmanship of Shri. Tarun Shridhar, IAS (Retd.):

It is understood that the proposed Breeding Act, 2026 and the Feed Act, 2026 are being drafted by the Department of Fisheries, Animal Husbandry and Dairy, Government of India, under the Chairmanship of Shri. Tarun Shridhar, IAS (Retd.). As deliberated during the meeting, while the implementation and enforcement of the Breeding Act will remain with the Department of Fisheries, Animal Husbandry and Dairy, the Feed Act—though drafted by the same Department—is proposed to be brought under the regulatory purview of the Food Safety and Standards Authority of India.

The meeting witnessed the participation of nearly 35 officials representing various departments and stakeholders. The discussions focused on the framework, scope, regulatory architecture, and implementation mechanisms of the proposed legislation, particularly in the context of ensuring quality, safety, traceability, and accountability within the animal feed sector.

From CLFMA OF INDIA, Col. Vinay Kumar attended the meeting and actively participated in the deliberations, representing the views and concerns of the feed manufacturing industry.

The meeting marked an important step towards establishing a comprehensive regulatory framework for the animal feed sector, aimed at strengthening governance, streamlining oversight, and promoting sustainable growth of the livestock industry in the country.

After attending a meeting, CLFMA has submitted a representation to Ms. Varsha Joshi, Additional Secretary (CDD/Trade/CE&P), New Delhi, requesting that the proposed Feed Act, as prepared by the Department of Fisheries, Animal Husbandry and

Dairying, may be retained under the purview of the Department itself—similar to the Breeding Act—and not be entrusted to FSSAI for subsequent monitoring and oversight.

Poultry India, along with CLFMA OF INDIA and Broiler Coordination Committee (BCC), supported by Vets in Poultry, organized a Poultry Seminar on 21st February 2026 at Le Méridien Coimbatore.

The Seminar on “Disease Dynamics and Control Strategies in Modern Poultry Production” was successfully held on 21st February, 2026 at Le Méridien, Coimbatore. The programme brought together poultry veterinarians, industry experts, academicians, integrators, and progressive farmers to deliberate on the emerging disease challenges in modern commercial poultry farming and the need for scientifically driven control strategies. Mr. R. Ramkuty, Treasurer of CLFMA and South Zone President, along with Mr. C. Saravanan, attended the Seminar as Guests of Honour.

In the context of rapidly intensifying poultry production systems, disease outbreaks continue to pose significant threats to productivity, profitability, and food safety. The Seminar highlighted how high stocking densities, environmental stress, evolving pathogens, and lapses in biosecurity contribute to complex disease dynamics. Experts emphasized that understanding the interaction between host, pathogen, and environment is critical for designing effective and sustainable disease prevention models.

Detailed technical sessions focused on major infectious and emerging diseases affecting broilers and layers, including viral, bacterial, and parasitic challenges. Speakers elaborated on the epidemiology and transmission patterns of key poultry diseases, the importance of early detection, and the role of advanced diagnostic tools such

as molecular testing and serological monitoring in timely intervention. The need for continuous surveillance and data-driven decision-making at the farm level was strongly underlined.

Vaccination strategies formed another important segment of the seminar. Experts highlighted the importance of selecting appropriate vaccines based on regional disease prevalence, maintaining cold chain integrity, and ensuring correct administration techniques to achieve optimum immunity. The integration of vaccination programs with nutritional support and stress management practices was presented as a holistic approach to improving flock resilience.

The Seminar also addressed the responsible and judicious use of therapeutics to combat antimicrobial resistance. Participants were encouraged to adopt integrated health management approaches that combine biosecurity, vaccination, monitoring, and targeted interventions rather than relying solely on medication.

Overall, the Seminar provided valuable insights into modern disease control strategies and reinforced the importance of a proactive, science-based approach to poultry health management. The interactive discussions and knowledge exchange helped participants strengthen their preparedness to tackle current and emerging disease challenges in the evolving poultry production landscape. A total of 65 officials attended the seminar.

CLFMA OF INDIA wrote a letter to GOI on 17th February, 2026:

CLFMA OF INDIA sent letter on 17th February, 2026 to Ms. Varsha Joshi, Additional CDD / Trade / CE&P, Department of AH&D, GOI, New Delhi on the subject CLFMA OF INDIA – On drafting and implementation of Feed Act 2026.



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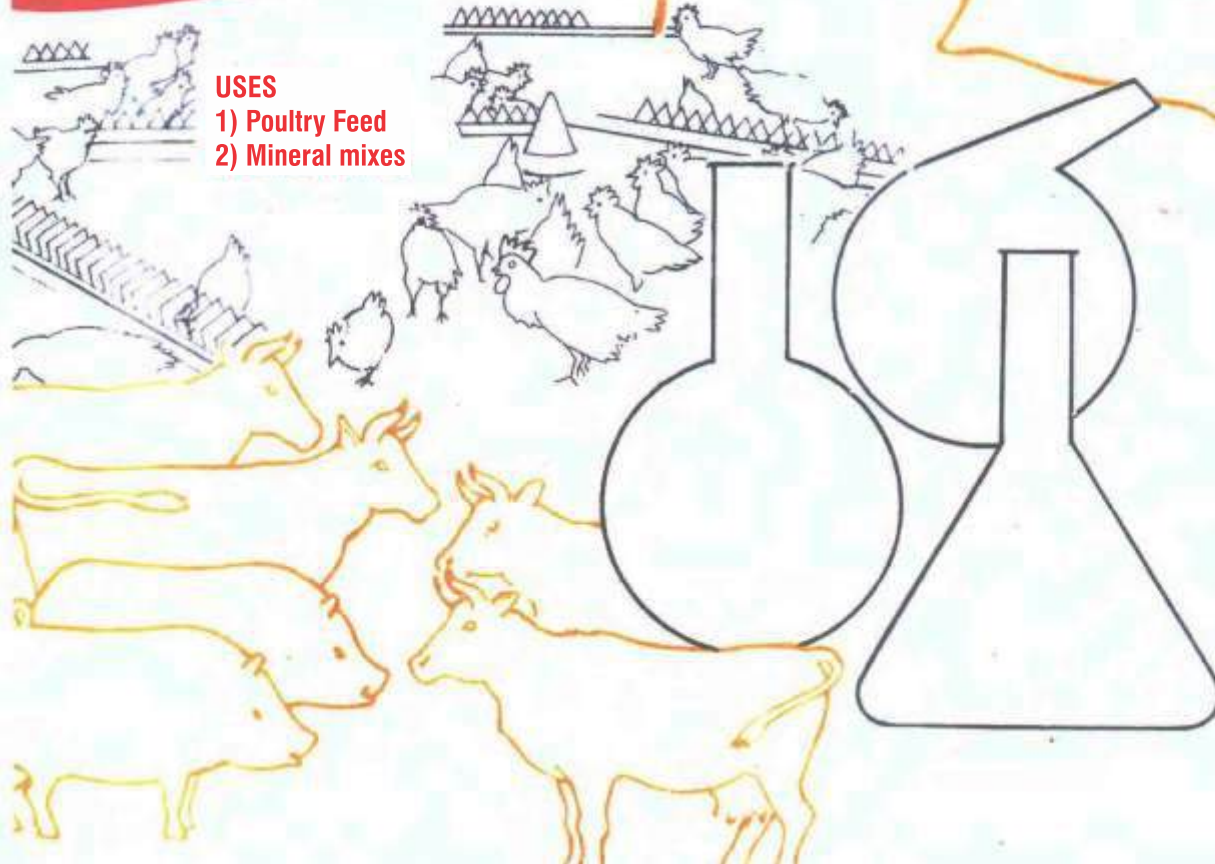


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CLFMA OF INDIA's participation in the FSSAI Convened a Stakeholder Consultation on Antibiotic Residues dated 17th February, 2026, New Delhi:

The Food Safety and Standards Authority of India (FSSAI) convened a Stakeholder Consultation on Antibiotic Residues on 17th February 2026 at 10:30 AM at its Headquarters, FDA Bhawan, 5th Floor, Kotla Road, New Delhi. From CLFMA OF INDIA Col. Vinay Kumar attended the same.

The consultation brought together representatives from industry associations viz. PFI, INFAH, etc., feed manufacturers, livestock and aquaculture stakeholders, regulatory experts, and other key participants to deliberate on important regulatory and operational aspects concerning the sector. The meeting provided a constructive platform for open dialogue, enabling stakeholders to share their views, practical concerns, and recommendations on implementation challenges and policy clarity.

Officials from FSSAI outlined the regulatory framework, objectives, and proposed approaches, while participants highlighted ground-level realities, the need for clear demarcation of authority, and the importance of streamlined compliance mechanisms to ensure ease of doing business without compromising safety and quality standards.

The interactive discussions were focused on fostering better coordination between regulatory bodies and industry stakeholders, strengthening transparency in enforcement, and ensuring that regulatory reforms are aligned with the growth and sustainability of the livestock and allied sectors.

The Consultation concluded with an assurance from FSSAI to examine the representations received and to continue engaging with stakeholders

for developing a balanced, practical, and effective regulatory framework. Almost 84 stakeholders participated physically and in online mode in the aforesaid meeting.

Poultry Seminar on 21st February, 2026 at Le Meridien, Coimbatore:

The IPR Knowledge Review on the theme "Disease Dynamics and Control Strategies in Modern Poultry Production" was organized by the Broiler Coordination Committee (BCC) in association with CLFMA OF INDIA, with the support of Vets in Poultry (VIP) on Saturday, 21st February, 2026 at Le Meridien.

The event brought together poultry industry experts, veterinarians, and professionals to discuss emerging disease challenges and effective control strategies in modern poultry production.

The programme was graced by Guest of Honour Mr. Uday Singh Bayas, representing the Indian Poultry Equipment Manufacturers Association and Poultry India Expo. Mr. C. Saravanan Chinnasamy, South Zone President of CLFMA OF INDIA, also attended as Guest of Honour. Mr. Divya Kumar Gulati, Chairman of CLFMA OF INDIA, was invited but could not attend due to an emergency.

The Keynote Address was delivered by Dr. P. K. Shukla, Professor and Head at DUVASU, Mathura, who emphasized the importance of biosecurity, disease surveillance, and integrated health management in modern poultry production.

Mr. R. Ramkuty, Treasurer of CLFMA OF INDIA and Chairman & Managing Director of Niswin Group, also addressed the gathering and highlighted the need for stronger collaboration between poultry producers, veterinarians, and feed manufacturers to address disease challenges effectively.

The review session facilitated

meaningful discussions on current disease dynamics affecting poultry production, preventive strategies, advances in veterinary science, and the role of industry stakeholders in strengthening health management practices. Participants appreciated the platform for knowledge sharing and emphasized the need for continued industry-academia collaboration to address evolving disease threats.

The event concluded with a shared commitment among stakeholders to strengthen biosecurity, adopt scientific management practices, and work collectively to ensure a resilient and sustainable poultry sector in India. Around 50 to 60 participants attended the event.





3rd Meeting of the Standardization Cell – 26th February, 2026:

The 3rd Meeting of the Standardization Cell was held under the Chairmanship of Shri. Sagar Mehra, Joint Secretary (Inland Fisheries), Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, on 26th February 2026 at 12:30 PM via video conference. From CLFMA OF INDIA, Ms. Shilpa Utekar, Manager CLFMA attended the Meeting.



Indian Chamber of Food and Agriculture (ICFA) Delegation Meets Joint Secretary, Ministry of Commerce to Discuss India-US Trade Engagements on 10th March, 2026:

On 10th March 2026, a delegation from the Indian Chamber of Food and Agriculture (ICFA) met Shri. Darpan Jain, Joint Secretary, Ministry of Commerce, Government of India, to discuss the evolving global trade landscape and the growing importance of bilateral partnerships for India, particularly in the context of India-US trade engagements.

The discussion focused on strengthening trade relations to support the growth of India's agriculture and allied sectors. The meeting highlighted the significant opportunities emerging from international trade collaborations and emphasized the importance of proactive policy engagement to enhance India's agri-import and export potential.

During the interaction, the need for continued stakeholder dialogue was underscored to ensure that India's agriculture and food sectors remain well-positioned to benefit from evolving global trade opportunities and partnerships.

Building on these discussions, it was decided unanimously that Indian Chamber of Food and Agriculture (ICFA) will convene a Roundtable Dialogue on "Growing Agri Exports by Leveraging Opportunities through FTAs and Trade Deals" on 19th March 2026 at India International Centre, New Delhi. The roundtable aims to bring together policymakers, industry leaders, and stakeholders to deliberate on strategies for enhancing India's agri exports while effectively navigating the evolving global trade architecture. Col. Vinay Kumar represented CLFMA OF INDIA at the meeting.

ICFA extends its sincere appreciation to the distinguished members of the delegation viz. Shri.Mohanji Saxena, Drs. Raju Kapoor, Shri. Durgesh Chandra Sharma, Dr. Yuvaraj Chopra, Shri.Kamal Singh and also to Ms. Shruti

Jaiswal and Ms. Ayati Singh from ICFA for their participation and valuable contributions. The Organization also thanks those who intended to join but were unable to attend due to unforeseen circumstances.

A special note of gratitude is extended to the leadership for their continued guidance and support in advancing ICFA's mission of strengthening India's agri and food sector.



Maize & Millet Summit 2026 – 13th & 14th March 2026 at The Leela Ambience, Gurugram:

CLFMA OF INDIA was invited to participate as a "Supporting Association" at the Maize & Millet Summit & Expo 2026, held on Friday and Saturday, 13th-14th March 2026, at The Leela Ambience, Gurugram. The summit was organized by Taso International and brought together policymakers, industry leaders, researchers, and stakeholders from across the agriculture and allied sectors.

Building on the success of its first edition, the Maize & Millet Summit 2026 aimed to further strengthen dialogue and collaboration among stakeholders involved in the production, processing, trade, and utilization of maize and millets. The event focused on sustainable agricultural practices, technological advancements, and emerging market opportunities, highlighting the growing importance of these crops in ensuring global food security and agricultural resilience.

Maize continues to witness strong

global demand due to its wide-ranging applications in human food, animal feed, and biofuel production, while millets are gaining significant traction owing to increasing consumer preference for nutritious, gluten-free, and climate-resilient grains. The summit served as a valuable platform for discussions on innovations, policy frameworks, and strategies to enhance productivity and market linkages in these sectors.

Representing CLFMA OF INDIA, Col. Vinay Kumar participated as a panelist during the summit discussions. During the deliberations, he highlighted the challenges faced by the Indian feed industry, particularly in relation to the availability and pricing of key feed ingredients. He emphasized the importance of ensuring adequate supply of protein sources for the livestock and poultry sectors and suggested the import of soybean meal as a measure to help address the domestic supply gap and stabilize feed costs.

Almost 200 participants attended the event, including industry leaders, policymakers, researchers, and stakeholders from across the agriculture, feed, and food sectors. CLFMA OF INDIA's participation in the summit underscored the association's continued commitment to engaging with stakeholders across the agriculture value chain and contributing to discussions that impact the livestock, poultry, and aqua feed sectors in India. The event also provided an opportunity to exchange perspectives with industry experts and explore collaborative approaches towards strengthening the maize and millet ecosystem in the country.



IFIF 1st Board of Directors Meeting on 18th March 2026:

Mr. Divya Kumar Gulati, Chairman of CLFMA of India, participated in the 1st Board of Directors Meeting of IFIF held virtually on 18th March 2026.



CLFMA OF INDIA's Participation in Round Table Discussion on "Growing Agri Exports by Leveraging Opportunities through FTAs and Trade Deals" on 19th March, 2026 at India International Centre, New Delhi:

CLFMA OF INDIA participated in the Round Table Discussion on "Growing Agri Exports by Leveraging Opportunities through FTAs and Trade Deals", held on 19th March, 2026 from 10:00 AM to 12:30 PM at Conference Room 1, Main Building, India International Centre, New Delhi.

The round table brought together key stakeholders from the agriculture and allied sectors to deliberate on practical

strategies to strengthen India's agricultural export potential by effectively leveraging Free Trade Agreements (FTAs) and global trade partnerships. The discussions focused on enhancing India's competitiveness in global agricultural markets while ensuring balanced outcomes that support farmer welfare and sustainable sectoral growth.

Key areas of deliberation during the round table included market access opportunities for Indian agricultural products, addressing non-tariff barriers such as Sanitary and Phytosanitary (SPS) measures and certification requirements, and strengthening domestic capacity for standards compliance and export readiness. Participants also discussed the importance of identifying priority sectors and products with high export potential, promoting value addition, and integrating Indian agriculture more effectively into global value chains.

The dialogue further emphasized the need to build a stronger export ecosystem, enhance infrastructure and regulatory support, and ensure that trade policies safeguard the interests of farmers while enabling the sector to benefit from expanding international market opportunities.

Col. Vinay Kumar represented CLFMA OF INDIA at the round table discussion and actively participated in the deliberations. The session provided a valuable platform for stakeholders to exchange perspectives and identify pathways for strengthening India's agricultural exports through strategic trade engagement and policy support.

Government Reviews Export Logistics Amid Middle East Conflict: Poultry, Meat & Dairy Industry Seeks Urgent Support:

A high-level delegation meeting was held at Krishi Bhawan, New Delhi on 19th March 2026 under the Chairmanship of **Shri Naresh Pal**

Gangwar (IAS), Secretary, Department of Animal Husbandry, Government of India. The agenda of the meeting was to review logistic availability for exports of perishable products like eggs, meat, and milk, which have been hampered due to disruptions in exports to Middle East countries-Oman, Qatar and the United Arab Emirates-amid the ongoing war conflict.

The meeting was attended by senior officials from **Department of Animal Husbandry and Dairying including Mrs. Varsha Joshi, Additional Secretary (DAHD), Dr. Muthukumarasamy, Joint Secretary (NLM)** and the trade representatives from several poultry and dairy associations; Poultry Federation of India, CLFMA of India, National Dairy Development Board, Indian Dairy Association, All India Poultry Breeders Association, Indian Egg Processors Association, All India Buffalo and Sheep Meat Exporters Association, All India Poultry Products Exporter Association, INFAH and Veterinary Vaccine Manufacturers Association.

Col Vinay Kumar, Executive Director, CLFMA also updated that the cost of feed premixes, feed additives, Amino-acids was increasing due to supply uncertainty and thus causing increase in feed cost.

CLFMA OF INDIA's Participation in Roundtable Dialogue on "Poultry for Protein Security: A Backbone of Nutrition Security for Viksit Bharat":

The Indian Chamber of Food and Agriculture (ICFA) organized a Roundtable Dialogue on "Poultry for Protein Security: A Backbone of Nutrition Security for Viksit Bharat" on 19th March, 2026 from 02:30 PM to 05:00 PM at the India International Centre, New Delhi.

The dialogue focused on the critical role of the poultry sector in addressing

India's nutritional challenges and strengthening protein availability for the country's growing population. The discussion highlighted the importance of poultry as one of the most affordable, accessible and efficient sources of high-quality animal protein, contributing significantly to improving dietary diversity and nutrition security.

The roundtable brought together policymakers, industry representatives, researchers, and other key stakeholders to deliberate on strategies to enhance poultry production, improve supply chains, and strengthen the sector's contribution to national nutrition goals. The participants also discussed the need for supportive policies, investment in infrastructure, improved feed resources, disease management, and promotion of poultry consumption to meet the protein requirements of the population.

The dialogue further emphasized the role of the poultry sector in supporting the vision of "Viksit Bharat" by contributing to nutrition security, rural livelihoods, and sustainable agricultural growth.

Representatives from across the poultry and allied industries actively participated in the discussions, sharing insights and recommendations aimed at strengthening the sector and ensuring greater availability of affordable protein for the nation.

DDGS Market Connect 2026 - 20th March 2026, India Habitat Centre, New Delhi

DDGS Market Connect 2026 was successfully held on 20th March 2026 at India Habitat Centre, New Delhi, bringing together industry experts, feed manufacturers, and stakeholders from the livestock and feed sectors to deliberate on the growing importance of Distillers Dried Grains with Solubles (DDGS) in animal nutrition.

The program began with Session 1, where Dr. Dinesh Bhosale delivered an

insightful presentation on "Types of DDGS - Maize, Rice, and Mix (Cake/Syrup Based), and Understanding Quality Parameters of DDGS." He elaborated on the different types of DDGS available in the market and emphasized the importance of maintaining quality standards, nutrient consistency, and proper evaluation parameters to ensure effective use of DDGS in animal feeds.

In Session 2, Shri. Divya Kumar Gulati, Chairman of CLFMA OF INDIA, addressed the gathering on the topic "DDGS in the Animal Feed Sector - Present & Future / Policy." He highlighted the growing role of DDGS as an alternative feed ingredient in India's livestock sector, especially in the context of fluctuating prices of conventional feed ingredients such as maize and soybean meal. He also spoke about the need for supportive policies, improved quality assurance, and greater awareness among feed manufacturers to maximize the potential of DDGS in the feed industry.

Later, in Session 4, Dr. Prashant Shinde, Member of the Technical Committee of CLFMA OF INDIA, presented on "Corn DDGS Quality & Impact of its Nutrient Profile on Dairy Cows." His presentation focused on the nutritional characteristics of corn DDGS and its benefits in dairy cattle rations, explaining how proper inclusion levels can positively influence milk production, feed efficiency, and overall herd health.

The event provided an excellent platform for meaningful discussions on the utilization, quality, and future prospects of DDGS in the Indian animal feed sector. Overall, DDGS Market Connect 2026 was well received and proved to be a productive event, facilitating knowledge exchange and strengthening collaboration among stakeholders working towards improving feed ingredient utilization in India. CLFMA Immediate Past President Mr. Suresh Deora also attended the said event.



CLFMA OF INDIA organized a National Dairy Seminar in collaboration with the Department of Animal Nutrition, College of Veterinary and Animal Sciences (CVAS) supported by KSE at Mannuthy, on Wednesday, 25th March 2026, at Mannuthy, Thrissur, Kerala:

scientific feeding practices, modern dairy management techniques, and innovative solutions to address challenges faced by the dairy sector.

The seminar witnessed enthusiastic participation from stakeholders across the dairy value chain and concluded with an engaging interaction between experts and participants, reaffirming CLFMA OF INDIA's commitment to promoting sustainable livestock nutrition and strengthening the dairy sector in India.



The Seminar brought together dairy farmers, feed manufacturers, academicians, industry professionals, and students to discuss emerging trends and best practices in dairy nutrition and management. The program aimed to strengthen awareness about efficient feeding strategies, improved herd management, and the use of quality feed ingredients to enhance dairy productivity and profitability.



The seminar featured a series of technical sessions delivered by experts from the dairy and animal nutrition sectors, covering key aspects of dairy farming and feed management. The discussions focused on Dairy Management Tips and the Use of U.S. DDGS in Dairy Diets, highlighting the nutritional benefits and practical application of DDGS as a valuable feed ingredient for improving milk production and animal health.



Another important session addressed the Feeding and Management of Calves and Transition Cows, emphasizing the importance of early nutrition, proper care during the transition period, and strategies to ensure better growth, reproductive performance, and overall herd productivity.



The seminar also included a session on Heat Stress Management in Dairy Cows, where experts discussed the impact of rising temperatures on dairy cattle and shared practical solutions to minimize stress, maintain feed intake, and sustain milk production during hot and humid conditions.



The event provided a valuable platform for knowledge exchange between industry and academia, enabling participants to gain insights into





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- SODIUM BUTYRATE COATED (30%,60% & 90 %)
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- CALCIUM BUTYRATE COATED (30%,60% & 90%)

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- FERROUS BISGLYCINATE

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- COPPER GLYCINATE 15 %
- MANGANESE GLYCINATE 15 %
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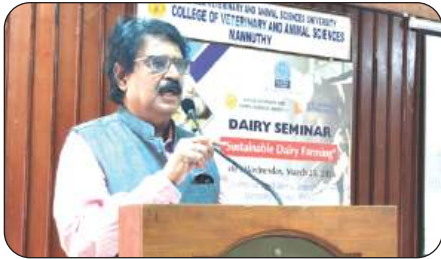
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MPEDA Virtual Meeting with Seafood Exporters of Karnataka and Goa on 27.03.2026:

The Regional Division of the Marine Products Export Development Authority (MPEDA), Mangalore, organized a virtual meeting with seafood exporters from Karnataka and Goa on March 27, 2026, at 10:30AM.

The meeting witnessed participation from around 38 stakeholders representing the seafood export sector. On behalf of CLFMA OF INDIA, Mr. Nissar F. Mohammed, Hon. Secretary of CLFMA, attended the session and also interacted.

The meeting focused on key industry issues and policy updates. The agenda included:

- Capacity Fixation of Fish Meal and

Fish Oil Units

- India-UK Comprehensive Economic and Trade Agreement (CETA)
- Participation in International Trade Delegations
- Updates on Seafood Expo Bharat (SEB) 2026
- E-Stat entry and export details
- Overview of MPEDA's financial assistance schemes

Discussions during the meeting highlighted the importance of Regulatory alignment, Export data transparency, and Strengthening India's presence in Global Seafood Markets. MPEDA officials also elaborated on various support schemes aimed at enhancing export competitiveness and encouraging industry participation in Global Trade Events.

Overall, the interaction provided a valuable platform for exporters to engage directly with MPEDA, seek clarifications, and share feedback on ongoing and upcoming initiatives.

Government Representation from CLFMA OF INDIA dt. 31st March 2026:

CLFMA of India wrote a letter to Ms. Varsha Joshi, Additional Secretary (CDD/Trade/CE&P), Department of Animal Husbandry and Dairying, GOI, New Delhi on 31st March 2026 regarding the inclusion of safe food-to-feed pathways in FSSAI guidelines on the disposal of food waste. In this connection, CLFMA enclosed a report on the utilization of substandard and expired food in animal feed.

India, Israel sign joint declaration to boost cooperation in fisheries and aquaculture

India and Israel on 14th January 2026 signed a Joint Ministerial Declaration of Intent to strengthen bilateral collaboration in the fisheries and aquaculture sectors, marking a significant expansion of cooperation between the two strategic partners. The declaration was signed during a high-level visit by an Indian delegation led by Union Minister for Fisheries, Animal Husbandry and Dairying and Panchayati Raj Rajiv Ranjan Singh, who was in Israel from January 13 to 15 to participate in the second global summit on "Blue Food Security: Sea the Future 2026" held in Eilat. Acknowledging the long-standing partnership between India and Israel, the declaration reflects a shared vision for sustainable development and recognises the critical role of fisheries and aquaculture in ensuring food security, livelihoods and economic growth. It also draws on Israel's advanced technologies in aquaculture, fisheries and water management, alongside India's vast and diverse aquatic resources. Under the agreement, both sides will collaborate on joint research and development in advanced aquaculture technologies, including recirculating aquaculture systems (RAS), biofloc, cage culture, aquaponics and aquarium systems such as oceanariums. Cooperation will also

cover breeding of high-yield species, pathogen-free seed improvement strategies, broodstock development, genetic improvement programmes, mariculture and seaweed cultivation, as well as efficient water management using Israeli water-saving technologies. The Ministry of Fisheries, Animal Husbandry & Dairying said that the declaration places strong emphasis on promoting start-ups and innovation in fisheries and aquaculture, with the broader objective of advancing the Blue Economy. It also underlines sustainable and responsible fishing practices aimed at conserving marine resources, reducing environmental impact and ensuring long-term resilience of fisheries. To support evidence-based management, the two countries will work together on technology-driven fisheries monitoring and data collection systems to improve transparency and traceability, while addressing the socio-economic needs

India's fisheries sector progressing toward financial formalization

The Indian fisheries sector is recognized as the "Sunrise Sector" has evolved from a primarily subsistence-driven activity into a dynamic engine of economic growth, government noted in a latest update. With a contribution of

1.12% to India's Gross Value Added (GVA), the sector plays a pivotal role in delivering nutritional security, providing affordable protein, and sustaining the livelihoods of nearly 30 million people. India today stands as the world's second largest fish producer and largest aquaculture producer, accounting for approximately 8% of global fish production. Over the past decade, the sector has achieved remarkable expansion fish production reached an all-time high of 197 lakh tonnes in FY 2024-25, nearly doubling from 95.79 lakh tonnes in 2013-14. This growth has been structurally reshaped by the rising dominance of inland fisheries, contributing over 75% of total production. The sector's gradual transition from capture-based fisheries to culture-based aquaculture has further strengthened production stability. In FY 2024-25, exports touched Rs 62,408 crore (USD 7.45 billion), with frozen shrimp as the major commodity and the United States and China as key markets. The sector contributes 7.26% to agricultural GVA. The government has set an ambitious target to increase national fish production to 220 lakh tonnes by FY 2025-26. The journey of credit flow to the sector has been digitized with real time tracking of loan request. All the 12 nationalized banks have been on boarded on the NFDP for easy and direct loan request to banks. The nationalized banks have been very supportive of the scheme and doing fabulous job in processing the loan requests. With strengthened digital financing rails, de-risked lending instruments, and customized institutional partnerships now in place, India's fisheries sector is progressing toward financial formalization and sustainable expansion.

Centre allocates ₹2,500 crore for fisheries sector under PM Matsya Sampada Yojana in Budget 2026-27

The Union Government has allocated ₹2,500 crore for the fisheries sector under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) in the Budget Estimates for 2026-27, the highest allocation so far under the scheme. According to information shared in the Lok Sabha by Union Minister for Fisheries, Animal Husbandry and Dairying Rajiv Ranjan Singh, the allocation marks a steady increase in budgetary support for the sector. The budget allocation under the scheme stood at ₹2,465 crore in 2025-26 and ₹2,352 crore in 2024-25. The government said the scheme aims to strengthen fisheries infrastructure, boost production and improve the livelihood of fishers and fish farmers across the country. Responding to a question in Parliament, the minister also provided details of financial support extended to Tamil Nadu under the scheme. During the last five financial years from 2020-21 to 2024-25, the Centre approved projects worth ₹1,240.95 crore for the state under PMMSY, with a central share of ₹479.73 crore. Out of the approved central share, ₹202.05 crore has been released so far to the Tamil Nadu government for implementing fisheries and aquaculture development projects. During the financial year 2025-26, the Centre initially released

₹50 crore to the state in April 2025 under PMMSY. Later, based on a request from the state government, an additional ₹20 crore was released in February 2026, taking the total central release to ₹70 crore for the year. The Tamil Nadu government has so far utilised ₹48.32 crore from these funds for implementing approved projects related to fisheries and aquaculture development. The scheme also provides welfare support to traditional fishers and small-scale fish farmers across the country. Assistance is extended for activities such as purchase of new fishing boats and nets, upgrading fishing vessels, and financial support during the annual fishing ban period to reduce income loss. Other initiatives supported under the scheme include sea cage farming, seaweed cultivation, ornamental fish farming and pearl farming, which help provide climate-resilient and alternative livelihoods for coastal communities. The government is also promoting mariculture activities such as cage culture and seaweed farming, along with training and capacity-building programs to improve the skills of fishers and encourage adoption of modern fishing technologies.

India's Fish Exports Grow To Rs 62,408 Cr Under PMMSY: Centre

The Department of Fisheries, under the Ministry of Fisheries, Animal

Husbandry and Dairying, is implementing the Pradhan Mantri Matsya Sampada Yojana (PMMSY) to enhance fish production, exports, and the welfare of fishers and fish farmers. The scheme focuses on increasing productivity, improving post-harvest infrastructure, introducing modern technology, and supporting sustainable, climate-resilient fisheries. The fish production has risen from 141.64 lakh tonnes in 2019-20 to 197.75 lakh tonne in 2024-25. Fisheries exports also grew from Rs 46,666 crore in 2019-20 to Rs 62,408 crore in 2024-25. The scheme has helped meet consumer demand, improve quality, and enhance the income of fishers and fish farmers. The Indian Council of Agricultural Research (ICAR) and its fisheries institutes continue to study climate change impacts and develop strategies for sustainable aquaculture. The 2022 report by ICAR-Central Marine Fisheries Research Institute (CMFRI) indicates that about 91.1 per cent of India's marine fish stocks are in healthy condition. Despite some variations caused by climate and environmental factors, marine fishery production has remained stable over the past five years, with no signs of acute shortages. Under the Climate Resilient Coastal Fishermen Villages (CRCFV) programme, PMMSY supports coastal communities by creating fisheries infrastructure and sustainable livelihood opportunities. Key initiatives include fish drying yards, processing centres, ice plants, cold storage, fishing jetties, shore protection works, seaweed cultivation, artificial reefs, and green fuel adoption. River and sea ranching projects are also supported to improve fish stock.

Poultry exports soar to a new high

Poultry exports are set for a record this financial year on robust purchases by countries such as United Arab Emirates (UAE), Indonesia and Japan among others. The re-opening of Dubai market for Indian poultry products is also aiding the demand trend, stakeholders said. For the first nine months of FY26, the exports have nearly doubled to a record \$237 million against \$119 million during the same period last year, as per data from the Directorate General of Commercial Intelligence and Statistics. In volume terms, the shipments have grown considerably to over 18.87 lakh tonnes (lt) over corresponding last year's 6.96 lt. Valsan Parameswaran, Secretary, All India Poultry Exporters Association, said demand from UAE, Oman and Dubai has pushed up the exports. Dubai, which is a major consumption centre, has opened up the market for Indian poultry after a gap of about 10 years and Indian products are competitively priced compared with Turkey and Iran, he said. In fact, the shipment value to UAE has seen more than a three fold growth during April-December this year. UAE has displaced Oman as the largest buyer with shipment value exceeding \$92 million during April-December this year when compared to \$23.14 million a year ago period. Countries like Indonesia and Japan, which import egg powder from India have seen the demand going up during this period. "While the UAE and Oman are big markets for Indian poultry, we are also trying to establish and make inroads into the newer markets like the

CIS countries, which is a very big market," said Divya Kumar Gulati, Chairman, CLFMA of India. "The confidence that we built up when we exported the eggs to the US last year is seen helping increase the overall shipments. We have been able to comply and our quality is improving," Gulati added. Besides the Gulf, Indian poultry exports have been going on to markets like Maldives and some West African countries, Parameswaran said. "Dubai is a good market for processed chicken, but it is occupied and dominated by Brazil and getting a foothold is a challenge," he added. "Though we have been able to successfully export the eggs and egg products, we are lagging in the shipments of poultry meat as our cost of production is still high due to higher raw material cost when compared to other origins like Brazil.

Poultry sector presents demands before the next Indian Budget

The Poultry Federation of India (PFI) has urged the government to extend support to boost feed raw materials and improve infrastructure in the poultry sector in the next Union Budget (2026/2027), to be presented in February. Ricky Thaper, Joint Secretary, PFI told Asian Agribiz, the Indian poultry industry in 2025-26 has grown at a steady pace with robust demand.

India ranks as the second-largest egg producer and the fifth-largest producer of broiler meat globally. "The size of the poultry industry reached a market size of over USD 30.46 billion and is projected to grow at a CAGR of 8.10% over the next decade." Given these trends, there is a surge in demand for corn for ethanol production that has started to influence prices and, correspondingly, feed costs. "The poultry industry, like other agricultural sectors, is subject to the supply and demand scenario, market structures, and the role of government policies. The poultry industry's expectation from the forthcoming budget is that the government should provide support to ensure that feed at reasonable prices is available throughout the year, and the government must formulate a long-term strategy keeping into consideration the rising demand of poultry products on feed supplies." The PFI has requested that the government initiate steps to increase production of key ingredients, such as corn and soybeans, and also liberalize imports of these raw materials to maintain stable poultry production. Mr Thaper proposed that GM soybeans and soybean meal, as well as corn imports, be allowed with a fixed quota during off- or non-harvesting seasons, so that they do not adversely impact farmers' price realization. "Reduction in import duties on these ingredients for poultry feed should be announced soon," he stressed. The PFI has requested that Animal Husbandry Infrastructure Development Fund be continued to support expansions in feed plants, breeding & layer farms, hatcheries, and meat processing units.

Centre launches 'White Revolution 2.0' to boost women's role in dairy sector

The Centre has launched a cooperative-led initiative, "White Revolution 2.0", aimed at expanding cooperative coverage in the dairy sector, generating employment and strengthening women's empowerment, the Lok Sabha was informed on Feb 09. The initiative, launched by the Ministry of Cooperation, seeks to increase milk procurement by dairy cooperatives by 50 per cent from the present level over the next five years by providing market access to dairy farmers in uncovered areas and increasing the share of dairy cooperatives in the organised sector. In absolute terms, milk procurement by dairy cooperatives is expected to reach 1,007 lakh kg per day by the end of 2028-29, the fifth year of implementation. The target will be achieved through a two-pronged strategy focusing on expanding the coverage of dairy cooperatives and deepening their reach. The programme also addresses issues of malnutrition through a series of activities under White Revolution 2.0. These include the setting up and strengthening of around 1.20 lakh new and existing Dairy Cooperative Societies (DCS), Multipurpose Dairy Cooperative Societies (M-DCS) and Multipurpose Primary Agricultural Credit Societies (M-PACS). The cooperatives will be linked with milk routes through the expansion of existing routes or the

creation of new ones. The initiative also providing enabling infrastructure such as Automatic Milk Collection Units, Data Processing Milk Collection Units, milk testing equipment and Bulk Milk Coolers, as per requirement, to support dairy activities. The activities under White Revolution 2.0 are being funded through the National Dairy Development Programme 2.0 (NPDD 2.0) of the Department of Animal Husbandry and Dairying. NPDD 2.0 will be implemented in accordance with guidelines issued by the department. Under the initiative, 75k new Dairy Cooperative Societies are proposed to be set up in uncovered areas, while 46,422 existing DCSs will be strengthened to market access, income opportunities and nutritional availability.

NDDB, WCOOPEF sign MoU to boost Co-op Growth

In a significant step towards building a prosperous India through cooperation, the National Dairy Development Board (NDDB) has signed a Memorandum of Understanding (MoU) with the World Cooperative Economic Forum, informs a social media post by IFFCO Chairman Dileep Sanghani. The agreement is expected to open new avenues in agriculture, dairy, cooperative commodity zones, renewable energy, and carbon markets. The partnership aims to empower farmers, strengthen cooperative institutions, and enhance their global recognition. It also aligns

with Prime Minister Narendra Modi's vision of "Viksit Bharat 2047." Besides Sanghani, Union Minister for Road Transport and Highways Nitin Gadkari, NDDB Chairman Meenesh Shah, MSP Committee member Vinod Anand, IIT Director Jiten Sharma, and Ranjan Banerjee were among the dignitaries present.

India consistently retained its top position globally in milk production: Govt

India has consistently retained its top position globally in milk production, contributing nearly 25 per cent of the world's total output. Over the decade, the sector has recorded a compound annual growth rate of around six per cent, with production increasing from 146 million tonnes in 2014-15 to over 247 million tonnes in 2024-25, representing a growth of over 69.4 per cent. This sustained expansion has contributed to improved nutritional access, reflected in per capita milk availability of 485 grams per day in 2024-25, significantly exceeding the global average of 328 grams. The government has said that India's agricultural progress is increasingly supported by the expansion of allied sectors such as livestock, dairy, poultry, and fisheries. These sectors have become major contributors to agricultural Gross Value Added and rural employment.

Use of Unconventional Feed Ingredients and Sustainable Gut Health Strategies in Poultry Production

Dr. Jalmeen Kour, MVSc

I. Introduction

The Indian poultry industry, especially broiler production, has evolved into a dynamic and technology-driven sector in India, growing at 8% CAGR (compared to 5% for agriculture sector). This growth is however accompanied with some critical challenges. Firstly, the entire industry is dependent on the traditional feed ingredients such as maize and soybean which not only make up 65-70% of the production costs but are also under stress due to competing human and industrial needs. This has worsened the issue of availability and affordability of feed.

Along with this, India's problem of post-harvest food loss stands at 40% for fruits and vegetables which is both an economic burden and an opportunity. Economically, this leads to a loss of over ₹92,000 crores per year, but it also makes it possible to turn food and vegetable waste into feed for poultry. Alternative feed ingredients can lower feed costs, and mitigate environmental burden. However, most of these unconventional feed sources also contain anti nutritional factors that impair nutrient absorption and hinder bird growth. The use of nutraceuticals to these sources has been regarded as a scientifically validated solution to sustain poultry nutrition while decreasing Antibiotic Growth Promoter's (AGP) dependency. This shift is becoming more significant with the FSSAI regulation prohibiting

the use of antibiotics in food animals from April 1, 2025. The policy seeks to mitigate antimicrobial resistance, secure food integrity, and restore consumer trust. Considering the propitious nutrient composition of vegetable waste and nutraceutical diets, broiler birds are remarkable candidates because they have a good feed conversion rate and short production cycles. However, dietary changes alone will not accomplish sustainable poultry production. Removal of heat stress and mortality that occurs due to temperature elevations needs to be improved by adopting solar powered and evaporative cooled housing systems along with low stress handling practices. These biosecurity measures and precise feeding plans enhance disease and economic efficiency which strengthen sustainability.

In light of these developments, this essay examines three key pillars critical to sustainable broiler production: the incorporation of unconventional feed ingredients supported by trial data, innovative management practices to address climate- and disease-related stress, and sustainable gut health tools that go beyond antibiotic growth promoters (AGPs).

II. Unconventional Feed Ingredients as Sustainable Alternatives

1. Fruit, Vegetable Waste, and Fibres

Post-harvest losses accounting for almost 40% of wastage includes vegetable and fruit by-products

containing fiber, vitamins, and phytochemicals and can be utilized in poultry's diet for lessening environmental wastage and for optimized eco-friendly solutions.

Dried vegetable waste (15%) involving cauliflower leaves, pea pods, nettle leaves and radish leaves serve as a low-cost fiber and energy-rich feed supplement. When combined with nutraceuticals like cinnamon extract and turmeric powder, this diet has shown positive growth performance, gut health viz. intestinal digesta pH, CFU count, intestinal villi health, improved feed conversion efficiency and carcass attributes in broilers under controlled Indian farm conditions (Jalmeen Kour, master's thesis).

Other fibre-rich by-products such as rice bran and corn bran play a beneficial role in gastrointestinal health via the introduction of short-chain fatty acids (SCFAs). Citric acid from citrus fruits improves the utilization of phosphorus and calcium resulting in improved feed utilization, weight gain, and overall performance. Functional feeds like *Azolla pinnata* have also shown benefits, such as increased muscle yield and gizzard development when paired with direct-fed microbials (Shambhvi et al., 2020).

In layer birds, combinations like Developed Supplemented Feed (DSF)-a mixture of vegetable waste and local herbs-have shown improved shell quality, mineral content, and egg

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production indicating the potential of blended functional diets in diverse poultry systems (Chauhan et al., 2024). Raza et al. (2019) suggested that vegetable waste could replace up to 75% of commercial broiler feed with beneficial effects. Nisar et al. (2022) observed enhanced body weight gain and carcass yield in broilers fed 25% vegetable waste (spinach, potato, and cauliflower). Fiber in the diet enhances gizzard function, resulting in more efficient digestion.

Collectively, these unconventional feed sources offer a sustainable direction towards an enhanced poultry performance, particularly when supported by focused nutraceutical interventions.

2. Insect Meal

Black soldier fly, housefly, mealworm, cricket/Locust/Grasshopper, earthworm, and silkworm are the most commonly used insect meals in poultry diets. Trials indicate that Black soldier fly (BSF) larvae meal can replace soybean meal with comparable or better performance. In addition to its nutritional profile, BSF meal provides ecological advantages by recycling organic waste into protein rich biomass, reducing total nitrogen excretion, and methane emission, making it an environmentally sustainable and inexpensive feed alternative.

3. Distillers Dried Grains with Solubles (DDGS)

DDGS is a by-product of the ethanol industry and is rich in protein and energy. It may function as a replacement for soybean meal and maize successfully. Because of its low cost and accessibility, DDGS is a useful ingredient in feed formulas that are price-sensitive.

III. Anti-Nutritional Factors and Mitigation Strategies

Most non-conventional feed ingredients contain compounds with anti-nutritional properties such as phytic acids, tannins, protease inhibitors, saponins, oxalates, and alkaloids. These compounds can adversely affect nutrient absorption and growth performance of the poultry birds. Such factors can be diminished by the use of nutraceuticals, which include enzymes, probiotics, herbs, minerals, vitamins, amino acids, and antioxidants. Nutraceuticals improve the gut health, boost immunity, and reduce the dependence on AGPs. Together, they pave the way for smarter, healthier approaches to poultry nutrition, which are discussed in the next section

IV. Innovative Poultry Management Practices

1. Climate-Responsive Housing Systems

Modern-day poultry farming has adopted Environmental Controlled Housing Systems (ECHS), which involves evaporative cooling pads, insulated roofing, and automated ventilation to alleviate heat stress. These systems maintain temperature, humidity along with pressure. Self-sustained solar-powered systems are a recent addition to poultry housing as they reduce carbon footprint and energy costs which advances environmental goals.

2. Bird Welfare and Stress Reduction

Stress in broilers declines growth and immunity. Management practices like natural lighting, pecking blocks and stress-free handling protocols are introduced to improve behavioural health and decrease corticosterone levels, resulting in lower mortality rates and better performance.

3. Disease Prevention and Biosecurity

Biosecurity measures such as

controlled farm access, disinfection tunnels, and all-in-out systems are highly beneficial in reducing the pathogen transmission. Additionally, natural immunity boosters like probiotics, phytobiotics, and organic acids are replacing antibiotics and supporting the bird health.

4. Precision Feeding and Nutrient Efficiency

Precision feeding and phase feeding involves preparing diets to precisely match individual nutrient needs, with minimising waste and improving feed conversion ratio. Such precision not only improves the performance but also reduces feed costs and nutrient runoff.

5. Early Nutrition and Epigenetic Programming

Technologies like in ovo feeding involves the delivery of essential nutrients directly into embryos enhancing gut development, immune system, and ability to withstand heat stress. This pre-hatch intervention improves long-term performance. These approaches promote healthy early growth, development and longevity.

V. Gut Health Management Using Sustainable Tools (Beyond AGPs)

1. Nutraceuticals

The ban on Antibiotic Growth Promoters (AGPs) is a response to growing issue over antimicrobial resistance, drug residues in food products, and consumer health. Due to these concerns the poultry industry is looking for alternatives which are sustainable, antibiotic residue-free and safer.

Nutraceuticals are natural feed additives that provide both nutritional and medicinal benefits. They can replace antimicrobials, enhance gut health, boost immunity and lessen

stress in poultry birds. However, they are affected by factors like age, stress level, dosage and environmental condition.

2. Categories of Emerging Nutraceuticals in Poultry Nutrition

a. Dietary Supplements

• **Probiotics & Prebiotics:** Probiotics are live microorganisms which are administered in adequate amounts and provide health benefits to the host as stated by a United Nations and WHO panel. Pathogen exclusion and SCFA enhancement are some of the actions performed by probiotics like *Lactobacillus*, *Bacillus*, and *Saccharomyces* species. They also improve gut health and immune function (Halder et al., 2024). While prebiotics are indigestible fibres that are neither hydrolysed nor absorbed in the gastrointestinal tract of host but act as a substrate for probiotics. Prebiotics such as inulin, FOS, and whole grain fibres stimulate beneficial gut microflora and improve digestion. According to studies, these combinations improve performance by increasing villus height, enzyme activity, and nutrition retention (Hashemi et al., 2022).

• **Antioxidants:** Nutrients such as vitamin E, vitamin C, lycopene, glutathione, selenium, carotenoids, and polyphenols help scavenge free radicals from host cells, thereby reducing oxidative stress. These antioxidants not only protect body tissues from oxidative damage but also support the immune system. Lycopene, which is present in carrots and tomatoes reduce the heat stress and improve overall performance in poultry birds. A recent study by Xiao et al. (2024) found that a compound containing BHT (butylated hydroxytoluene), TBHQ (tert-butylhydroquinone), and citric acid

enhanced gut barrier function, maintained tight junction integrity, and boosted immune response, while also increasing beneficial *Lactobacillus* levels in broilers. Additionally, dietary polyphenols appear to be effective in improving antioxidant defenses under stress conditions.

b. Nutritional Substances

• **Amino Acids:** Amino acids play a crucial role in promoting feed intake, improving immune function and synthesizing protein in poultry birds by influencing various metabolic processes. Example: Tryptophan is a precursor to serotonin which can stimulate feed intake and also reduce stress. Leucine plays a role in energy balance and appetite regulation. Threonine and glutamine support the intestinal structure, improving nutrient absorption. Methionine and cysteine reduce oxidative stress. In addition, in ovo feeding of amino acids (e.g., methionine, cysteine) in heat-stressed embryos has been found to improve lipid metabolism and antioxidant gene expression in broiler chicks (Yadav & Jha, 2019).

• **Fatty Acids (PUFAs):** Fatty acids like omega-3 and omega-6 support immune system, bone development, and enhance mineral absorption in poultry. When included in the diets of broilers and layers, PUFAs can help prevent infectious diseases and improve both egg production and quality. When the dietary omega-6 to omega-3 ratio is set to 5.5:1, it enhances the characteristics of the yolk by increasing the omega-3 content and boosting the immune response in poultry (Attia et al., 2022).

c. Phytobiotics, Essential Oils, and Phytosterols

Plant-derived compounds found in herbs, spices, essential oils, fruits, and grains are commonly known as Phytobiotics, phytochemicals or

phytochemicals. These natural substances provide a variety of benefits such as antimicrobial, antioxidant, anti-inflammatory, and growth-promoting properties, making them highly valuable alternatives in sustainable poultry nutrition.

Common phytobiotics such as garlic (*Allium sativa*) contains allicin that may lower the synthesis of cholesterol and improve lipid profile in broilers (Chakraborty & Roy, 2021). Cinnamon (*cinnamomum* spp.) contains an active ingredient called cinnamaldehyde, which has been linked to reducing *Eimeria* oocyst shedding and controlling coccidiosis (Youn et al., 2008). Similarly, turmeric (*Curcuma longa*) known for its active component curcumin, has demonstrated anti-inflammatory and antioxidant properties. When used in combination with cinnamon, it has been shown to improve growth performance, liver function, and oxidative stress resistance in heat-stressed broilers (Kanani et al., 2016).

Betaine or trimethylglycine is an important phytobiotic that has been studied due to its presence in foods like; sugar beets, spinach, wheat bran and barley. In poultry nutrition betaineserves dual functions; it act as a methyl donor, providing additional support to metabolic processes including protein and DNA synthesis, and as an osmolyte, maintaining the cellular water balance under stress. Betaine supplementation has been shown to improve digestibility, gut morphology and muscle growth of broilers, while also reducing environmental ammonia emissions (Abd El-Ghany et al., 2022). A more recent study conducted by Sharma et al. (2025) reported that dietary betaine at 0.25% level preserved growth performance on methionine-deficient broiler diets while also significantly

decreasing carcass fat and breast cholesterol.

Essential oils like thymol, carvacrol, and piperine also possess antimicrobial activity and stimulate the digestive enzymes thus improving feed utilization (Windisch et al., 2008). Essential oils help in forming a healthy intestinal environment.

Plant-derived compounds such as phytosterols, are found in soy, corn, and sunflower. These sterols assist in the regulation of lipid metabolism, muscle development and the reduction of cholesterol in serum. In poultry diets, their incorporation not only enhances meat quality but also meets the consumer's demand for leaner and healthier poultry meat (Poli & Visioli, 2019).

Combining phytobiotics with phytosterols forms a powerful and multi-functional approach to the nutrition of poultry. They support the intestinal structure and functions, boosts the immune system, and improves the nutrient absorption while decreasing the use of AGPs.

d. Bioactive Compounds

Bioactive peptides containing 3 to 50 amino acids, are obtained from the hydrolysis of animal by-products. These peptides possess antioxidant, antihypertensive, antihyperglycaemic, and anti-inflammatory abilities which increases the bioavailability of nutrients, and the sensory properties (Vasconcellos et al., 2024). Meat proteins are the major sources of animal protein.

Examples of plant protein sources of

bioactive peptides include soy, chickpeas, oats, beans, peas, lentils, wheat, hemp seed, canola, and flaxseed. Casein and whey proteins present in milk have natural angiotensin-converting enzyme inhibitors and antihypertensive properties. Studies show fish-derived peptides delay lipid oxidation, improving meat shelf life, while sesame meal peptides reduce *E. coli* colonisation and improve gut morphology and performance (Aslam et al., 2020).

e. Functional Foods and Microalgae

Functional foods have bioactive compounds incorporated into them to garner health advantages or disease prevention. Such foods go beyond the basic requirements of sustenance. These foods serve the purpose beyond giving just nutrition and include offering enhanced immunity. Microalgae, widely used as a nutraceutical feed additive, is rich in bioactive compounds such as carotenoids, phycocyanin, and polyunsaturated fatty acids — all known for their anti-inflammatory and antioxidant effects. Varieties like *Spirulina*, *Arthrospira platensis*, *Chlorella vulgaris*, *Staurosira* spp., and *Schizochytrium* spp. have been shown to enhance poultry meat quality, strengthen immune responses, boost omega-3 levels, and improve resistance to pathogens. (Bonos et al., 2016; Zanella & Vianello, 2023).

VI. Conclusion

With the rising global demand for safe and affordable protein sources, the poultry sector has a unique

opportunity to grow and thrive. However, it must maintain high productivity while effectively addressing challenges such as antibiotic resistance, environmental sustainability, and public health concerns. Meeting these problems requires a change to scientifically sound, sustainable bird health, and economized feed utilization.

Inclusion of non-conventional feed ingredients such as fruit and vegetable waste offers a more practical and economical approach than traditional feed constituents. When used alongside plant-based nutraceuticals like turmeric, cinnamon, and probiotics, these diets have the possibility to lessen the reliance on antibiotics by improving the gut health, immune function, and enhance feed conversion efficiency.

Field evidence, including the author's own research under Indian climatic conditions, supports that such dietary shifts can improve a bird's productive performance, health, and welfare while increasing profitability. Furthermore, the use of climate-responsive shelters alongside smart precision nutrition, and other strong biosecurity measures is vital in containing diseases, environmental strain, restoring consumer trust by providing safe poultry products and dwindling inputs. Educating farmers and providing hands-on training ensures that these strategies are effectively implemented at the field level.

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Mitigation of Mycotoxins in Poultry Feed by Phytogetic Extracts

Prof. Dr.R.N.Sreenivas Gowda*

Mycotoxins are toxic secondary metabolites produced by fungi that contaminate poultry feed ingredients like maize, wheat, and soybean meal. These stable compounds persist through feed processing and can cause "mycotoxicosis," a condition characterized by significant health and productivity losses in poultry.

There are several methods to reduce feed toxicity in poultry operations, one latest approach is to use of phytogetic extracts,

Phytogetic extracts mitigate mycotoxins in poultry feed through a multi-layered approach: they act as **antifungals** to prevent initial contamination, **biosorbents** to bind toxins in the gut, and **biological mitigants** that counteract systemic toxicity through antioxidant and anti-inflammatory pathways.

1. Mechanisms of Mitigation

- **Antifungal Activity:** Phytogetics like **cinnamon**,

oregano, and **thyme** essential oils inhibit the growth of mycotoxigenic fungi (Aspergillus, Fusarium) by disrupting fungal cell walls and membranes.

- **Biosorption:** Some plant extracts, such as **grape pomace**, contain polysaccharides and proteins with functional groups that bind mycotoxins (e.g., AFB1, ZEN) through hydrophobic and polar interactions, facilitating their excretion.
- **Systemic Detoxification:** Active compounds like **curcumin** and **silymarin** upregulate hepatic detoxifying enzymes (e.g., inhibiting **CYP450** to prevent the activation of Aflatoxin B1).
- **Antioxidant & Anti-inflammatory Support:** Mycotoxins induce oxidative

stress; phytogetics neutralize free radicals and modulate inflammatory signaling pathways (e.g., **Nrf2**, **NF-κB**) to protect vital organs like the liver and kidneys.

3. Impact on Poultry Performance

- **Growth Recovery:** Supplementation significantly improves **Body Weight (BW)** and **Average Daily Gain (ADG)** in birds exposed to contaminated feed.
- **Feed Efficiency:** These extracts help restore the **Feed Conversion Ratio (FCR)** by protecting intestinal villi and ensuring proper nutrient absorption.
- **Residue Reduction:** Studies show that phytogetic-enhanced binders can significantly reduce mycotoxin residues (AFB1, OTA) in pectoral muscle and liver tissues.
- **Immune Resilience:** Phytogetics counteract mycotoxin-induced immunosuppression by increasing antibody titers and supporting lymphoid organ development (e.g., **Bursa of Fabricius**).

LIVER PROTECTION

Phytogetic extracts protect the poultry liver from mycotoxins through complex cellular signaling pathways and specific liquid formulations that

2. Key Phytogetic Extracts & Effective Doses

Phytogetic Extract	Common Source	Primary Targets	Typical Effective Dose in Poultry
Curcumin	Turmeric (Curcuma longa)	AFB1, OTA, ZEN	400 - 500 mg/kg feed
Silymarin	Milk Thistle (Silybum marianum)	AFB1, OTA, DON, ZEN	5 - 10 g/kg (max range)
Grape Pomace	Red/White Grape skins/seeds	AFB1, ZEN, OTA	80 - 100 g/kg diet
Garlic/Ginger	Bulbs/Rhizomes	Aflatoxins	~2 g/kg feed
Olive Pomace	Olive byproduct (Olea europaea)	Multi-mycotoxin	600 g/ton (dietary)

optimize the bioavailability of these plant-derived compounds.

1. Molecular Pathways in Liver Protection

Phytochemicals mitigate liver damage by modulating genes and proteins involved in detoxification and antioxidant defense:

- **Nrf2 Pathway Activation:** Extracts like **curcumin** and **citrus flavonoids** activate the Nrf2 pathway, which serves as a "master switch" for antioxidant enzymes. This increases the production of superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), which neutralize mycotoxin-induced free radicals.
- **Phase I & II Detoxification:** Phytochemicals regulate enzymes like **Cytochrome P450 (CYP450)** and **Glutathione S-transferase (GST)**. For instance, grape and olive pomace extracts enhance detoxification by modulating EPHX1 expression, allowing the liver to process and excrete toxins like Aflatoxin B1 more efficiently.
- **NF-κB Inhibition:** Many mycotoxins trigger inflammation. Extracts from **turmeric** and **thyme** inhibit the NF-κB pathway, suppressing the release of pro-inflammatory cytokines such as **TNF-α, IL-1β, and IL-6**.

2. Commercial Product Comparison

Commercial products are moving away from single-ingredient formulas toward complex "multi-layered" solutions.

Product Type	Examples	Key Components	Best Use Case
Purified Clay	HSCAS	Pure aluminosilicates	High-risk Aflatoxin environments; cost-sensitive
Dual-Action/Hybrid	Clentox®Bind	HSCAS + Yeast Cell Walls	Broad-spectrum protection; supports gut health
Phytochemical-Fortified	MYTOX FS	Clays + Plant Extracts + Organic Acids	Multi-toxin contamination; improves liver resilience
Complex Multi-Mode	TOXO-XL	Clay + Biotransforming agents	Advanced risk management for high-value breeders

- **Cell Membrane Stabilization:** Saponins and essential oils help maintain the integrity of hepatocyte (liver cell) membranes, preventing the leakage of liver enzymes like **ALT** and **AST** into the blood, which is a hallmark of liver damage.

2. Liquid Anti-Mycotoxin Solutions (LAS)

Liquid formulations are often preferred for rapid administration via drinking water, especially when birds show reduced feed intake due to mycotoxicosis.

- **Standard Composition:** High-efficacy liquid solutions often combine **grape and olive pomace extracts**. Some commercial blends also include organic acids (e.g., **glacial acetic acid, propionic acid**) and minerals like **copper sulphate** to act as mold inhibitors.
- **Solubility Enhancements:** Because some phytochemicals (like curcumin) have low water solubility, liquid formulations may use solvents like olive oil or **nanocapsulation** to ensure the active compounds remain stable and bioavailable in the water system.
- **Dosage & Administration:**
- **Preventive:** Typically **0.5 ml per liter** of drinking water for 3–5 days.
- **Curative:** Increased to **1.0–2.0 ml**

per liter (or 2 liters per 1000 liters) for 5–7 days or throughout the risk period.

- **Key Benefits:** Liquid solutions are shown to improve **Body Weight (BW)** and **Feed Conversion Ratio (FCR)** while reducing the relative abundance of specific toxins like **Tenuazonic Acid (TeA)** in the liver.

COMBINATION OF TOXIN BINDER CLAY WITH PHYTOCHEMICALS

Modern mycotoxin management often uses a **"dual-action" strategy**, combining the high physical adsorption capacity of clays with the biological protective power of phytochemicals.

1. Interaction: Synergy vs. Independent Action

While conventional clay binders and phytochemicals operate via different mechanisms, they are highly complementary:

- **Complementary Binding Profiles:** Conventional clays (like **HSCAS** or **bentonite**) are excellent at trapping **polar toxins** like Aflatoxin B1 but are often ineffective against non-polar toxins like **Zearalenone** or **DON**. Phytochemicals and yeast cell walls fill this gap by binding non-polar toxins through hydrogen bonds and van der Waals forces.
- **Biological "Safety Net":** Clays can never bind 100% of toxins. Phytochemicals provide a secondary defense by neutralizing any "escaped" toxins that enter the bloodstream, protecting the liver through antioxidant and anti-inflammatory pathways.
- **Nutrient Preservation:** A major drawback of using high doses of clay is the non-selective binding of essential vitamins and minerals. Including phytochemicals allows for a lower inclusion rate of clay, reducing the risk of nutrient deficiency.

3. Performance Outcomes

Research indicates that combining these two additives yields better results than using either alone:

- **Regenerative Effects:** Binders fortified with phytogenics (containing algae or complex terpenoids) have been shown to


activate endogenous stem cells in spleen tissue, aiding organ repair.

- **Gut Health:** Birds fed a combination of phytobiotics and toxin binders show significantly greater villus length, leading to superior Feed Conversion Ratios (FCR).

These analyses compare commercial

mycotoxin binders, focusing on the interaction between phytogenics and clay.

(*Former and Founder VC, KVAFSU, Bidar. Former Director, IAH&VB, Bangalore and Former Prof and University head, Dept. of pathology, Veterinary College UAS Bangalore)



ASSOCIATION OF LIVESTOCK SECTOR

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.

You are requested to kindly block your dates for 59th Annual General Meeting and 67th National Symposium 2026.

With warm regards,



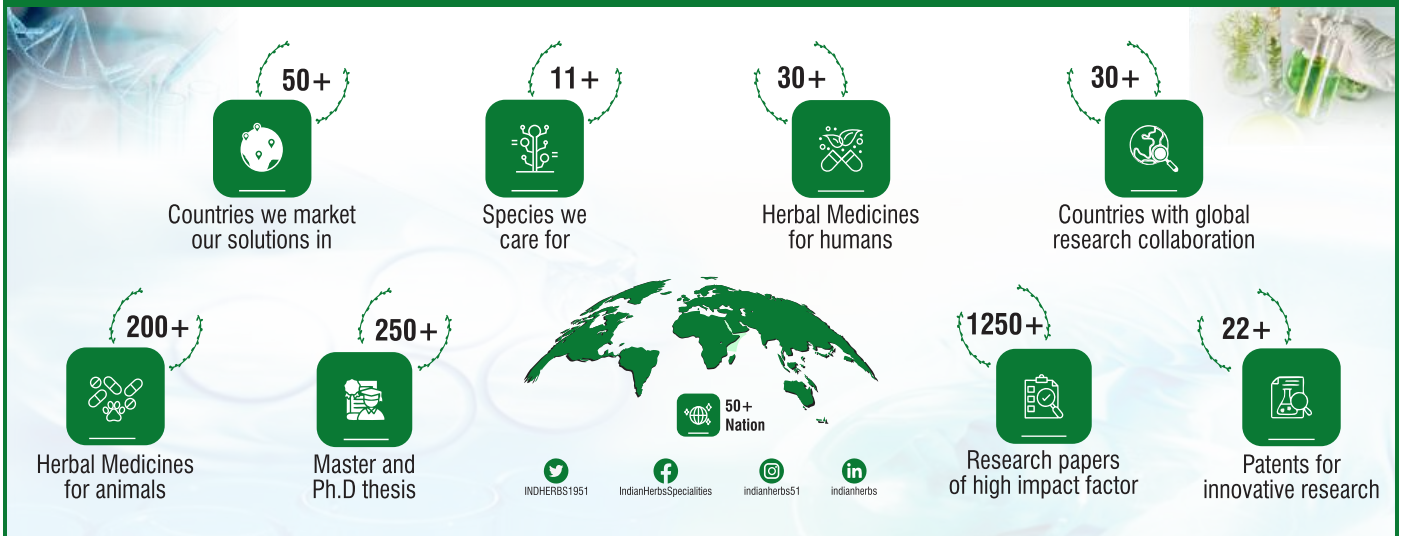
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Innovations in Dairy Management Practices to Control Cost of Production of Milk in Various Climatic Conditions with Relevant Data

Dr. Rashmi Thakare, PhD Scholar, NEERI

INTRODUCTION

Dairy sector is a backbone of rural Bharat and nutritional security – it helps in food and livelihood generation. Bharat is the largest milk producing country in the world with an annual production of over 220 million metric tons (FAO 2023). A large part of this achievement is due to the contribution of small and marginal farmers. Many of them depend on just 2–3 milch animals to support their families. However, behind the success, there are some structural and environmental challenges that threaten the sustainability and profitability of dairy farming.

Dairy production in Bharat is highly sensitive to climatic variations. Climate change has worsened regional temperature, rainfall, and resource imbalances, increasing stress on the dairy systems. The increased frequency of heatwaves in arid areas, cold waves in mountainous terrains and diseases in humid regions, affects the milk yield, animal health and farm economics. As the cost of production is increasing due to the price of feed, energy, labour and veterinary costs, the infrastructure (adaptive) needs to be developed depending upon the additional resilient strategies. According to estimates, the production cost ranges from ₹24 to ₹38 per liter depending on breed and climate and location (NDDDB, 2022)

These challenges are not unique to Bharat. Throughout the world,

experience in relation to the Ethiopian and New Zealand dairy sectors shows that socio-economic as well as policy constraints can hinder the uptake of innovation even though the need is evident (Kebebe et al., 2015; Beukes et al., 2010). This stresses the importance of a strong climate-smart management solution based on local conditions.



In this complex context, **innovations in dairy management are no longer supplementary—they are fundamental.** The transformation of traditional dairy systems into resilient, cost-efficient, and sustainable systems is only possible through integrated innovation. This innovation encompasses feed, genetics, automation, health, and climate adaptability. The interventions stabilize milk production, cut costs, enhance animal welfare, and reduce negative impact on the environment.

Why Innovation in Dairy Management is Essential

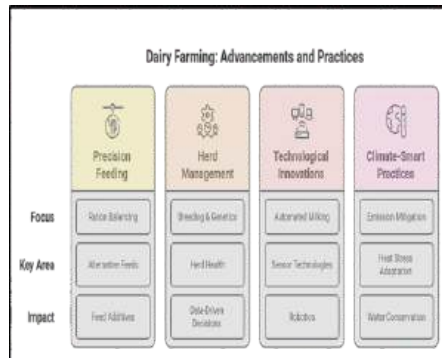
Innovating dairy management is critical for addressing the twin challenges of economic sustainability and climate resilience. As input costs for feed, water energy and labour keep increasing, existing practices are no longer sufficient to remain profitable. Milk production systems are also getting affected due to highly variable climates and extreme temperatures, constant diseases outbreak and erratic rainfall. The utilization of precision feeding, climate-smart breeds, robotic milking and data monitoring of livestock optimises resource use, enhances productivity and improves animal health. Aside from wastage reduction, increase in milk yield per animal, minimal environmental impact etc. they make sure dairy farming is possible in a constantly changing environment. In short, if there is no innovation, the industry will stagnate; if there is, it will be an example of sustainable, inclusive, and future-ready agriculture.

We need an integrated strategy that includes improved feeding and breeding practices as well as increased health care, housing, and mechanisation. Innovation is no longer a nice-to-have for the future. It is now essential as it reduces climate change and creates wealth for people. This essay explores a spectrum of such innovations and evaluates their role in controlling production costs across varied climatic conditions, thereby shaping the future of a more equitable and efficient dairy industry.

INNOVATIONS IN DAIRY MANAGEMENT PRACTICES

Innovations in Feeding Strategies

A feed strategy innovation based on baled silage and bypass protein improves feed efficiency and its influence on animal productivity and minimizes production cost (Nimbalkar, Verma, & Singh, 2021).



Precision Feeding and Ration Balancing: With precision feeding and ration balancing, one can achieve greater efficiency in milk production and also reduce detrimental environmental effects. Precision feed management characterizes delivering sufficient nutrients i.e. neither excess nor inadequate, to maximize nutrient uptake and minimize excess. A New York study found that when dietary crude protein (CP) was lowered by 9.7%, manure nitrogen excretion dropped by 14%, and income over purchased feed costs increased by \$137 per cow per year (Chase & Fortina, 2023). This technique benefits the economy, reduces nitrogen emissions, and is also environmentally friendly. It reduces the carbon footprint of dairy farming as well.

Use of Alternative Feed Resources: Employing various feed resources is important in dairy farming to reduce expenditures during changing seasons. It was demonstrated through a multi-period linear programming model that changes in available feed types will yield significant benefits. For instance,

barley can replace wheat, corn and sorghum at certain price spreads. According to Alqaisi et al. (2019), feed costs decrease by 11% compared to grain-based case studies.

Feed Additives and Their Impact on Efficiency: By feed additives, the efficiency of dairy cows in milk production can be enhanced considerably. Functional Feed Supplement (FFS), an example of feed additive. A recent study on Holstein cows showed that the 305-day daily milk production and feed efficiency were improved for cows fed FFS containing encapsulated cinnamaldehyde, condensed tannins, capsaicin, piperine and curcumin. These additives can also help in improving solids-not-fat yield and enhance the energy output of the milk (AlSuwaiegh et al. 2022).

Advancements in Dairy Herd Management

A dairy herd's productivity and sustainability have steadily improved over the years. As per Farm Journal (2025), the activities of data geeks and renewable energy solution providers are proving a lot useful for the herd against diseases and deadly impact. If we all work together, these strategies are very important and can make future dairy farmers successful.

Improved Breeding and Genetics: Enhancing the breed and genetics of cattle is crucial in improving the productivity of dairy cattle at a minimum production cost under varying climate conditions. Genetic selection has greatly improved the per cow milk yield across species. So, now's the case where some cows gave 20,000 kg or more milk per lactation. Nevertheless, the rise in milk production has not been without problems. These problems link to lower fertility, greater mastitis incidence and less longevity, all of

which may harm overall herd health and economic viability (Oltenucu & Broom, 2010). A multi-trait selection scheme focusing on health, fertility and yield is being adopted with greater frequency by the breeding programs to solve these problems. One example is the Profitable Lifetime Index (PLI) in the UK; it takes mastitis resistance and fertility into account. According to Oltenucu and Broom (2010), this selection program could enhance profits up to 80% more than selection on milk alone. Sustainable management of dairy animals and milch breeds requires these.

Optimizing Herd Health and Disease Prevention:

In dairy management, herds health optimization and disease prevention are necessary to prevent losses in productivity and save from costs. The HACCP system is used in dairy farms and small enterprises to spot health hazards and control it before it poses any harm. Prevention is always better than cure (Lombardo; 2017). Consequently, the idea is to take preventive actions rather than reactive ones in order to protect herd health. This will ultimately ensure quality milk production.

Data-Driven Decision Making in Herd Management:

To enhance different management protocols in herd management, data-driven farmers have adopted dynamical models to project lactation curves that can improve productivity at minimum costs. Adjusting these management practices to specific herds and environments with using of past data (Rodriguez-Obando et al., 2022) can make this possible.

Technological Innovations in Dairy Farming

Introduction of automatic milking systems and smart sensors is helping dairy farming get more productive and efficient. Farmers today are exploiting

new technologies to keep track of cow health and milk quality more accurately and reduce their labour costs. (New York Dairy, 2024).

Automated Milking Systems (AMS): Automated Milking Systems (AMS) are an important technology that can help manage dairy cows, improving cost-effectiveness while reducing labour. Using AMS can help cut down on labor costs. These savings can be as high as \$200/cow/year when hired labor is replaced (Rotz et al., 2003). It's particularly beneficial for smaller farms where labour costs are very high.

It has also been shown to increase milk production by milking cows more frequently (up to three times per day). The result is a milk yield that is 3 to 11% greater than that from typical dairies (Rotz et al. 2003). However, the adoption of AMS does come with challenges. The AMS comes with a hefty price tag. In fact, farmers may be put off because they cost two to three times as conventional milking systems. Moreover, even with AMS raising up milk volumes, there may be a small lowering in milk fat concentration. Also, there may be a rise in feed costs due to the increased demand. Despite the above issues, AMS is likely viable for small farms in the northeast USA, where labour is expensive, and one must expand farms to be profitable (Rotz et al. 2003).

Sensor Technologies for Monitoring Animal Health and Productivity: Sensor Technologies for Monitoring Animal Health and Productivity: Sensors are now being used to monitor health and productivity of the animal thus revolutionizing the dairy management. With the help of non-invasive sensors with an accelerometer, microphone and temperature sensor, the behavioural change of dairy cattle that signals a health issue can be detected. These

sensors can be incorporated into a device worn on the animal, which can give a continuous stream of health data. Identifying conditions like mastitis and lameness early can improve the farm's profitability and the welfare of the animals (Awasthi et al., 2016).

Robotics in Feeding and Manure Management: The integration of robots in feeding operations and also managing waste on a dairy farm enhances its efficiency and the efficiency of dairy engineers. Automatic feeding systems (AFS) provide completely or partially mixed rations and provide stimuli that encourage visiting feeding devices and automatic milking systems. In the Netherlands 22 dairy farms were researched of which 54.5% of the farms AFS use confirmed positive management effects whereas the milk production results were higher than expected (Bisaglia et al., 2012).

Climate-Smart Dairy Practices

Raising the calving interval of cattle and minimizing the carbon footprint of the farmer will lessen the impact of climate change on the cost of milk production. As per Maindi et al, 2020, improved management of feeds, efficient use of water among other practices help promote resilience and sustainability under varied climatic conditions.

Mitigation Strategies for Greenhouse Gas Emissions: The environmental impacts of dairy farming mitigated through mitigation strategies in the dairy sector for greenhouse gas (GHG) emissions. Feeding strategies can be altered so as to reduce the enteric methane (CH₄) emissions from the dairy industry that are part of the greenhouse gases (GHG). As per a study, replacing grass silage with maize silage in diets of dairy cows can help reduce enteric CH₄ emissions by about 8% at the animal level. Nonetheless, it is important to evaluate

strategies at different levels, including farm and chain levels, as land-use change and adaptation of management practices can cause an increase in CO₂ and N₂O (Van Middelaar et al., 2013). This method of cultivating assures that a farmer's efforts to reduce one GHG does not lead to increase in any other GHG. Apart from dietary modifications, enhancing production efficiency can also be utilised to reduce GHG emission.

A modeling exercise on New Zealand dairy farms showed that improving production efficiency through better cow genetics, pasture management and the use of nitrification inhibitors could reduce GHG emissions by 27-32%. Using new software and equipment will cut down emissions. They can make the farm's more efficient. Further, it will save on costs like feed and fertilisers. (Beukes et al., 2010). Using all those strategies in farm management practices has positive environmental effects and ensures economic benefits. This made them a good option for any dairy farmer looking to reduce their environmental footprint without sacrificing production or profit.

Adaptation Strategies for Heat Stress Management: Dairy cows can experience heat stress that can be alleviated with adaptation strategies. To minimize the effects of heat stress on cattle, the installation of a fan and sprinkler cooling system is essential to decrease the ambient temperature. Moreover, providing supplements like electrolytes and antioxidants has been found to assist the animals in coping with the physiological impacts of heat stress (Renaudeau et al., 2012). It may be possible to improve breeding practices through selecting heat-tolerant strains that better adapt to high temperature conditions and do not affect milk yield over a period of time. When grouped together, all of

these plans assist in duvet production in hot climate.

Water Management and Conservation: In order to meet the increasing demand for dairy products,

it has become essential to ensure sustainable milk production through water management and conservation in dairy farming. Proper management of water resources can be achieved by enhancing irrigation and reusing

runoff to wash and milk systems. As per Shine et al., 2020, dairy sustainability will help reduce costs, environmental footprint, and water use while enhancing farm efficiency.

Table: Dairy Innovations: Benefits, Cost Impact & Climatic Suitability

Innovation Category	Primary Benefit	Estimated Cost Reduction (INR/Litre)	Climatic Suitability
Precision Feeding	Reduced feed waste & cost	1.4	All zones
Alternative Feeds	Flexible feed selection	1.2	All zones
Feed Additives	Higher milk efficiency	1.6	All zones
Genetic Improvement	Improved yield with sustainability	1.8	All zones
Disease Prevention	Reduced treatment cost	1.5	All zones
Automated Milking Systems	Lower labor cost & increased yield	2	Cold & Composite
Sensor Monitoring	Early disease detection	1.7	All zones
Robotic Feeding	Efficient feeding & manure handling	1.3	Cold & Composite
GHG Mitigation Strategies	Reduced methane emissions	1.9	All zones
Heat Stress Adaptation	Better animal welfare in heat	1.5	Arid & Humid
Water Management	Lower water usage & cost	1	Arid & All

Table: Region-wise Innovation Strategy Matrix

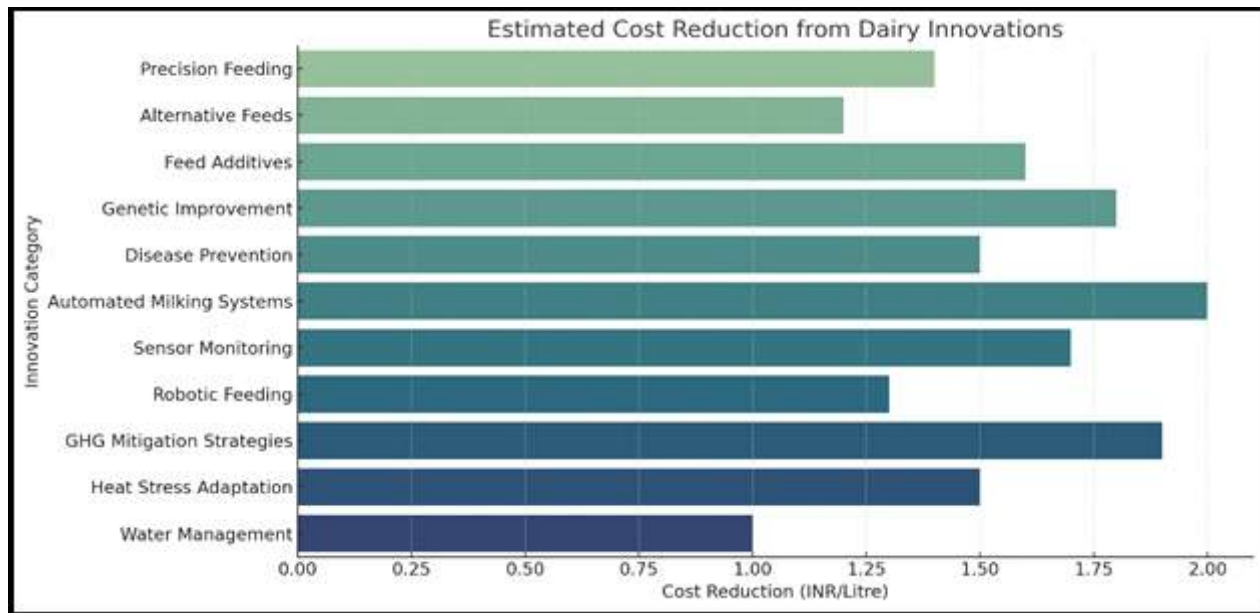
Region/Climate	Key Innovations	Implementation Focus	Expected Outcomes
Arid/Semi-Arid	Hydroponics, Solar Cooling, Heat-Resilient Breeds	Water saving, thermal stress mitigation, local feed production	Reduced water and feed costs; improved milk yield during summers
Humid/Subtropical	Probiotics, Parasite Management, Misting Systems	Health risk reduction, housing hygiene, productivity maintenance	Lower veterinary costs; improved milk hygiene and animal welfare
Cold/Mountainous	Insulated Housing, Silage Storage, Solar Heating	Cold stress adaptation, energy efficiency, year-round feeding	Stable milk production in winter; reduced energy expenses
Composite/Transitional	TMR, Biogas Units, Digital Monitoring	Balanced systems, tech integration, cooperative strategies	Scalable and adaptable model; consistent yield and cost efficiency

ECONOMIC ANALYSIS AND ADOPTION BARRIERS

Numerous research work results indicate that the herd management system control cost with the adoption of technology shows much promise.

For instance, Uddin et al. (2010) shows that an intensive dairy system used in Bangladesh makes use of lesser input units per output unit in comparison to a traditional system indicating a higher economic gain. Other things such as

labor cost and the existing efficiencies already present on the farm (Olynk & Wolf, 2008) for U.S. commercial dairy farms may also hinder using new reproductive management strategies.



Cost-Benefit Analysis of Innovative Practices:

It is important to evaluate the cost-benefit analysis of such innovative management practices in the dairy sector. The various scenarios of manure management farmed at large fur dairy farming and studied in Sefeedpari et.al (2019). This study examines eight scenarios involving the development of anaerobic digestion (AD) composting, solid-liquid separation and so on to study their techno-economic environmental. The analysis demonstrates that despite the high upfront costs, investing in AD is a worthwhile practice, as it can reduce GHGs and recover nutrients. It can thus be considered a lucrative investment because of funding for renewable energy projects. This implies that the economic and environmental effects of dairy production jointly should be considered when choosing the manure management option.

On the contrary, Diro et al (2019) study

in the central highlands of Ethiopia is based on cost-benefit analysis of small and large dairy farms. The study showed that large emerged dairy farms are more profitable than small ones besides the benefit-cost ratio is 2.24 and small is 1.43. This occurs because larger farms can create goods in a more cost-effective manner. This means that they have a lower cost per unit. Moreover, they receive additional payment for the milk they sell and for the calves. Feed cost, technical assistance and market access are some of the constraints dairy farmers face which may constrain the profitability of dairy farmers according to Diro et al. (2019).

Farmers whose perception of Macroeconomic instability (inflation, in particular) is greater, as well as farmers with a greater revenue level benefit more from country-net benefits than those with lower revenue. The research can help in this benefit

analysis. As per the studies, the adoption of such innovative practices in dairy management may significantly enhance both economic and environmental benefits. For instance, use of AD reduces greenhouse gas emissions and improves recovery of nutrients which contributes to the circular economy of agriculture. To successfully implement such practices, farm size, resources and market conditions should be considered. It is imperative for policymakers and stakeholders to work together to ensure a conducive environment supported with financial incentives and technical assistance to farmers for the uptake of sustainability. Cost benefit analysis of many innovations with respect to dairy management matters a lot. All manure management practices must be improved to achieve greater sustainability and profitability of the dairy industries. Farmers have some issues around manure

management planning. According to Diro et al. (2019) and Sefeedpari et al. (2019), this study's findings suggest that a case-study approach provides great insight into how people weigh the costs and benefits associated with an innovation that will assist group production.

Barriers to Adoption and Strategies for Overcoming Them

Barriers to adoption of innovative dairy management practices: financial, technical, and social. Financial constraints become a barring factor that limits innovativeness because the financial investment in new technologies or practices is large. Small-scale farmers may lack access to loans or cash to cover expenses. The complexities of new systems and the lack of technical knowledge or training in farmers create technical hurdles which would affect the effective implementation of BMPs. Two social barriers are resisting changes and lack of peers' support (Bechini et al., 2020).

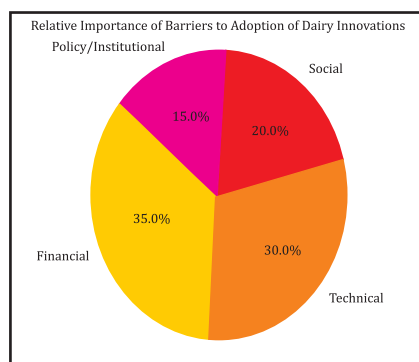


Table: Barrier Type and solutions

Barrier Type	Description	Suggested Solutions
Financial	High upfront cost for technologies and infrastructure	Credit access, cooperative financing, capital subsidies
Technical	Lack of knowledge, training, and complexity in use	Extension services, mobile training, demonstration farms
Social	Resistance to change, peer influence, cultural norms	Community engagement, success stories, peer-led groups
Policy/Institutional	Lack of supportive subsidies, credit, insurance, infrastructure	Integrated policy, inclusive insurance, rural infrastructure

Policy and Regulatory Considerations. The law established by the USDA manages the cost of production under a variety of weather conditions. Federal Milk Marketing Orders (FMMO's) and Dairy Margin Coverage (DMC) programs stabilize the milk price and provide a safety net for the dairy producer respectively. FMMOs and DMC assists farmers in managing costs. FMMOs help to set minimum pricing structures that reflect current market conditions. The DMC is a safety net against variable price feed costs (USDA, 2025). These policies work to help the dairy industry be more resilient.

CONCLUSION

In summary, the adoption of innovative dairy management practices is key to tackle the challenges of milk production in various climatic conditions. The research reveals that these innovations can enhance productivity and cut down production costs. According to Nimbalkar et al. (2021), using cost-effective and easy innovations designed for farm-level use can enhance animal productivity and the socio-economic status of farmers. It is especially important applying it in underdeveloped nations where traditional practices prevail and resources are scarce (Nimbalkar et al., 2021).

The wider benefits of these innovations go beyond cost reduction. In light of global environmental issues, the sustainability of dairy farming practices has been gaining importance. The utilization of technology-oriented solutions like automated devices and

digital monitoring can enhance the efficiency of agricultural processes and support this global trend (Stanevich et al., 2019). The waste utilization and better use of agricultural inputs help in enhancing the quality of milk production, which is resilient.

In addition, these innovations face many hurdles including socio-economic constraints to make them successful but need policy support too. As highlighted in the research, constrained access to capital, poor infrastructural development and technical incompetence of farmers are some of the reasons responsible for the low diffusion of these technologies (Nimbalkar et al., 2021). To solve these problems, everyone has to work together - the government, schools, and businesses. They need to give help and training to farmers.

The future of dairy farming will be in adaptation and innovation. The results of this study show how the dairy industry will be able to remain sustainable and competitive through innovation. As the sector continues to evolve, it is critical for all the stakeholders to create such an environment that fosters innovation and secures the livelihood of the farmers along with growing demand of the world for dairy products. Dairy farming must adapt to the times, using new technologies to improve it. It is hoped that dairy farming will become a lot more technologically advanced.

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Good People, Great Engineering

Importance of Millets as Feed and Fodder

Ruchika Bhardwaj, R S Sohu and Ravi Prakash Pal

The agricultural sector is under tremendous pressure to maintain its sustainability in a changing environment and burgeoning human and cattle population. In these scenarios, crops are required to cope with a changing environment at the same time fulfilling the production demands. One such group of crops i.e. millets have been found to show a remarkable promise with multiple benefits, viz., production (short duration, less water consumption and climate resilience), consumption (nutrition and health), and ecology (carbon neutral). Once used to be cultivated as traditional crops, particularly pearl millet (Bajra), millets have come to be looked down upon as “coarse grains” in the present scenario. The millets also called nutri-cereals or dry land cereals are categorized into major millets as sorghum (jowar) and pearl millet (bajra), finger millet (ragi) and minor millets as foxtail millet (kangni), little millet, kodo millet (kodon), barnyard millet (samvatke chawal), proso millet (chena) and brown top millet (hari kangani). Many studies have shown that millet grains have evidently used to replace conventional grains in the feed of ruminants as well as birds. Even the feeding trials have shown the positive effect on growth of those animals and birds whose diets were substituted in different proportions with millet grains

Millets for green forage and feed

Millets particularly bajra and sorghum

are major fodder crops of *kharif* seasons. They are grown during *summer* and *kharif* and can be preferred over the contemporary crop maize as millets require very less water for crop growth. Exclusive forage producing sorghum and pearl millet varieties/ hybrids are available at PAU which produce superior quality fodder for feeding livestock. Many multi-cut type hybrids are available in these crops which ensure continuous supply of green fodder during *kharif* and *summer* seasons. Pearl millet uses less water per unit of forage production, tolerates both lower and higher soil pH and higher aluminium concentration, and is rich in minerals as compared to sorghum. However, sorghum has a wider range of adaptability and is more widely grown. Sorghum has forage quality better than that of other millets and next only to maize. Low-lignin brown mid-rib varieties of sorghum forage quality is equivalent to that of forage maize in USA. Sorghum is the major supplier of green and dry fodder in India and its role becomes important during the lean period of winter and summer months. It is estimated that sorghum fodder constitutes 20-45% of the total dry weight of feed of dairy animals during normal seasons and up to 60% during the lean summer and winter seasons. The importance of sorghum is more pronounced in areas where livestock enterprise is one of the important livelihood strategies of people.

Forage sorghums are principally

cultivated in Punjab, Haryana, Delhi, western and central Uttar Pradesh and adjoining areas of Madhya Pradesh. In these states, it is grown during *kharif* and summer seasons, either as single-cut (mostly in *kharif*, as rainfed) or as a multi-cut (summer and *kharif*) irrigated forage crop. Intensive cropping, short growing season, nutritional quality and the need for continuous supply of green fodder created demand for forage sorghum in northern India.

Sweet sorghum is used to a limited extent in producing sorghum syrup and 'jaggery' (raw sugar) in India and has recently gained importance in ethanol production for blending with petrol under national biofuel policy. Sweet stalked sorghum is used to produce bioethanol which can be blended with petrol to reduce the pollution as well as cost.

Finger millet may also be used as sole forage crops as they provide good quality forage. Finger millet straw is used in many parts of the country for feeding all categories of animals, such as working animals, milch animals and dry animals. This serves as an important source of dry fodder which is a must in the daily ration at least in small quantities. It is said that for all kinds of cattle, finger millet straw is superior to that of rice.

Silage potential of millets

Sorghum and pearl millet have the potential to produce excellent yields of higher quality forage,

especially during growing seasons with favorable moisture. It can provide high tonnage silage with good nutritive value. An adequate supply of quality fodder during the lean periods of Nov-Dec and May- June can be ensured by preserving the green fodder as silage. Non- legume fodders such as maize, sorghum, and pearl millet are rich in sugars and carbohydrates and low in protein, possess excellent quality for conserving as silage. Harvest the crop for silage when nutrient content is at

their peak stage and it has enough dry matter. A crop with 30-35% dry matter conserves into a high-quality silage. Furthermore, in comparison to maize, which is in high demand by the farmers for its silage potential, it has been found in the research trials that both sorghum and bajra are suitable millets for silage making in terms of yield potential as well as quality. Thus, these millets can help in erasing the pressure for cultivation of maize as a silage.

Thus, the millets have a potential to

ensure food security, nutrition, health and sustained economical livelihood. These crops can be rightly called as multi-faceted all season crops with multiple benefits. Even in case of bird feed and as ruminant's diets, millets particularly pearl millet has proven itself to be equivalent to corn or even superior.

Forage, Millets and Nutrition Section
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Evaluation Of Feasible Technology To Use Fish Processing Waste For Aqua Feed Manufacturing

Dr. Bhupika

The global aquaculture industry is experiencing rapid growth, driven by increasing demand for seafood and the need for sustainable food sources. However, this expansion has led to significant environmental concerns, particularly regarding the sourcing of fishmeal, a primary ingredient in aquaculture feed. Traditional fishmeal is derived from small pelagic fish, often caught unsustainably, raising issues related to overfishing and ecosystem disruption. Consequently, there is a pressing need to explore alternative sources for aquaculture feed that are both sustainable and economically viable.

Fish processing waste, which includes by-products such as viscera, bones, skins, and heads, constitutes a substantial portion of the fish harvested globally. These by-products, often discarded or underutilized, represent a valuable resource for developing alternative feed ingredients. This essay evaluates various technologies for converting fish processing waste into high-quality aqua feed, focusing on their feasibility, nutritional benefits, and environmental impact.

1. Fish Silage Production

Fish silage is a liquid product obtained through the fermentation of fish waste using acids, enzymes, or lactic acid-producing bacteria. This process hydrolyses proteins and lipids, making them more digestible for aquatic animals. Fish silage serves as an excellent alternative to traditional fishmeal, offering a sustainable and

cost-effective solution for feed production.

The production of fish silage involves several steps: collection of fish waste, addition of acid or bacterial cultures, fermentation, and storage. The resulting product is rich in proteins, lipids, and essential micronutrients, making it suitable for incorporation into aquaculture feeds. Studies have demonstrated that fish silage can replace a significant portion of fishmeal in feed formulations without adversely affecting the growth and health of aquatic species.

One of the key advantages of fish silage is its ability to utilize low-value fish by-products, thereby reducing waste and promoting resource efficiency. Additionally, the fermentation process can enhance the nutritional profile of the feed, increasing its appeal to aquaculture producers seeking high-quality ingredients. In India, where fish processing waste is abundant, fish silage production aligns with sustainability goals under initiatives like the Blue Economy Policy and the Swachh Bharat Mission.

2. Fermentation with Microbial Cultures

Fermentation using microbial cultures, such as lactic acid bacteria and yeasts, offers an innovative approach to processing fish waste into valuable feed ingredients. This biotechnological method not only improves the nutritional quality of the feed but also introduces beneficial microorganisms that can enhance the health and growth of aquatic animals.

Lactic acid bacteria, recognized as Generally Recognized as Safe (GRAS), are particularly effective in fermenting fish waste. They produce bioactive compounds with antimicrobial and antioxidative properties, which can promote gut health and immune function in aquatic species. Yeasts, on the other hand, contribute immunostimulatory compounds like β -glucans and mannan oligosaccharides, further enhancing the feed's efficacy.

The fermentation process involves inoculating fish waste with selected microbial cultures, allowing for enzymatic breakdown of complex nutrients, and producing a fermented product rich in proteins, lipids, and bioactive compounds. This method is advantageous as it eliminates the need for harsh chemical treatments, resulting in a more environmentally friendly and cost-effective feed ingredient.

3. Solid-State Fermentation (SSF)

Solid-state fermentation (SSF) is a process where microorganisms grow on solid substrates in the absence of free water. This technique has been applied to convert fish processing waste into valuable feed ingredients. SSF utilizes agricultural by-products, such as lemon peel, as fillers during fermentation, providing additional nutrients and prebiotic effects.

The SSF process involves inoculating fish waste with specific microbial cultures and incubating the mixture under controlled conditions. The resulting fermented product is rich in proteins, lipids, and prebiotic

compounds, making it suitable for inclusion in aquaculture feeds. The addition of agricultural by-products not only enhances the nutritional profile but also contributes to waste reduction and sustainability.

SSF offers several advantages, including the efficient use of low-moisture substrates and the production of high-quality feed ingredients. However, challenges such as the need for precise control of fermentation conditions and potential variability in product quality must be addressed to ensure consistency and scalability.

4. Enzymatic Hydrolysis

Enzymatic hydrolysis is a process that uses specific enzymes to break down complex proteins and lipids in fish waste into simpler, more digestible forms. This method produces fish protein hydrolysates, which are high in amino acids and peptides, making them valuable components in aquaculture feeds.

The enzymatic hydrolysis process involves selecting appropriate enzymes, controlling reaction conditions, and optimizing parameters to achieve desired product characteristics. The resulting hydrolysates can be incorporated into feed formulations to improve nutrient absorption and growth performance in aquatic species.

While enzymatic hydrolysis offers high-quality feed ingredients, it requires careful control of processing conditions to ensure product consistency and quality. Additionally, the cost of enzymes and processing equipment can be a limiting factor for widespread adoption.

5. Microbial Cultivation on Fish Processing Wastewater: Fish processing wastewater, often rich in organic matter, presents an opportunity for microbial cultivation to produce valuable feed ingredients. The use of microorganisms, such as *Aspergillus oryzae*, to cultivate on wastewater can yield biomass suitable for inclusion in aquaculture feeds.

The cultivation process involves inoculating wastewater with selected microorganisms, allowing for growth and biomass production under controlled conditions. The resulting microbial biomass is rich in proteins and other nutrients, making it a viable alternative to traditional feed ingredients.

This approach not only provides a sustainable use for wastewater but also contributes to waste reduction and resource efficiency. However, the variability in wastewater composition and the need for precise control of cultivation conditions can pose challenges to scalability.

6. Direct Conversion Technologies

Direct conversion technologies involve processing fish waste into feed ingredients without extensive pretreatment. These methods aim to simplify the conversion process, reducing costs and energy consumption.

One such technology developed by the Central Institute of Fisheries Technology (CIFT) involves the direct conversion of fish market discards into high-quality floating or sinking fish feed. The process utilizes a customized machinery line comprising shredder, pulverizer, blender, extruder, and drier to process fish waste into feed pellets.

This technology has been successfully demonstrated in various fish markets and offers a practical solution for utilizing fish waste at the point of generation. The simplicity and efficiency of the process make it an attractive option for small-scale producers and local communities.

CONCLUSION

The utilization of fish processing waste for aqua feed manufacturing presents a promising avenue for sustainable aquaculture practices. Various technologies, including fish silage production, fermentation with microbial cultures, solid-state fermentation, enzymatic hydrolysis, microbial cultivation on wastewater, and direct conversion methods, offer viable solutions for converting fish waste into valuable feed ingredients.

Each technology has its advantages and challenges, and the choice of method depends on factors such as the type of fish waste available, processing infrastructure, and economic considerations. However, the overarching benefits include reduced environmental impact, cost-effective feed production, and improved resource efficiency.

As the aquaculture industry continues to grow, the adoption of these technologies will play a crucial role in ensuring the sustainability and resilience of the sector. By leveraging fish processing waste as a resource, the industry can move towards more circular and environmentally friendly practices, contributing to the global goal of sustainable food production.

Factor involved in post weaning diarrhoea and measure to mitigate it

Dr. Ashish Tiwari, MVSc scholar

INTRODUCTION

Post-weaning diarrhoea (PWD) in piglets typically appears between 3 and 10 days after weaning, leading to more profuse diarrhoea, dehydration, and reduced feed intake that manifest to slow growth and increase mortality rates, imposing a significant economic burden on pig producers worldwide costing the industry hundreds of millions annually. This condition arises due to the abrupt transition from sow's milk to solid feed, combined with environmental stressors and an underdeveloped immune system. These factors collectively disturb gut health, creating an imbalance that favours the excessive growth of harmful microbes. Enterotoxigenic Escherichia coli (ETEC), mainly strains with F4 (K88) or F18 adhesins, often take advantage of disturbing small intestinal state in piglet, adhering to the duodenum and jejunum and produce toxins that interfere with fluid imbalance.

ETIOLOGY

Enterotoxigenic Escherichia coli (ETEC), mainly those strains that carry F4 (K88) or F18 fimbriae, attach themselves to receptors present on the small-intestinal lining and release toxins that disturb the gut's normal fluid balance. But post-weaning diarrhoea is not caused by ETEC alone but it is the result of combination of many etiological agents acting together, including many viral

infections like rotavirus or porcine epidemic diarrhoea virus, even some pathogenic bacteria such as Salmonella, Lawsonia intracellularis, and Brachyspira, protozoan

Why postweaning diarrhoea is important

Post weaning diarrhoea (PWD) is very serious problem for swine producers because it affects piglet overall health, farm profitability, and overall system resilience:

Feed Conversion and Growth:

Diarrhoeic piglets eat less and make poorer FCR, meaning even a short period of illness can reduce their growth and raise the cost of reaching market weight and even gain less weight.

Health and Survival Rates: In severe cases, PWD can cause more diarrhoea and dehydration in piglet body that

subsequent may cause death. Even mild infections affect piglets weakened and more vulnerable to other secondary infection in piglets

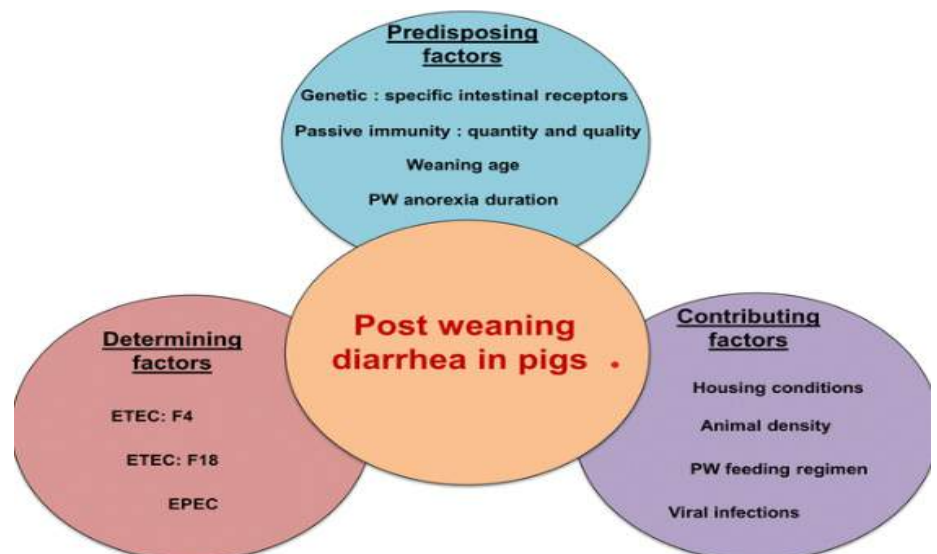
Veterinary Expenses and Drug Use:

ETEC infection in PWD piglets often increase extra vet clinic visits, more labour, and routine antibiotic treatments. Cutting down on PWD helps farms save on these costs and aligns with tightening rules and consumer expectations around antibiotic use.

Operational Efficiency:

Fewer disease cases mean less contaminated waste to manage and more predictable pen turnover in pig farm. This stability makes scheduling cleaning, restocking, and resource allocation smoother and more cost-effective.

Factors Contributing to Post-Weaning Diarrhoea



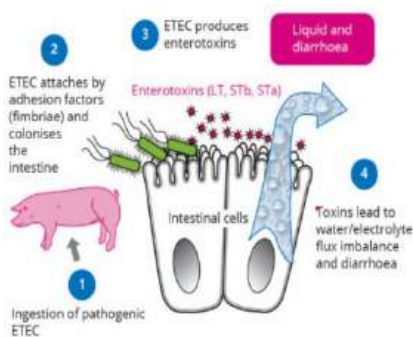
Infectious agent

Enterotoxigenic Escherichia coli (ETEC):

Enterotoxigenic Escherichia coli (ETEC) is the main bacterial etiological agent behind PWD in newly weaned piglets, as these organisms rapidly colonizing the small intestine and increase fluid loss. There is specialize hair-like fimbriae present in bacteria mainly consists of F4 (K88) and F18 that bind to corresponding receptors present on enterocytes and the bacteria firmly attach to the gut lining. after attachment, ETEC secretes heat-labile (LT) and heat-stable (STa/STb) toxins, which disturb the host's ion channels and signaling pathway and increase excessive chloride and water secretion into the intestinal lumen and resulting in profuse diarrhoea.

This pathogenic sequence occurs in two main stages:

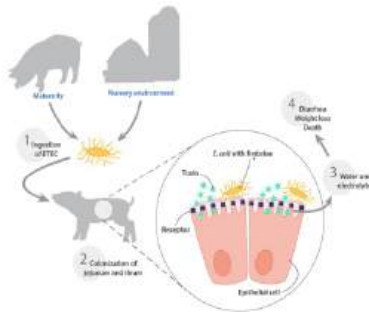
(1) Adhesion: F4 or F18 fimbriae bind specifically with F4R or F18R proteins on villus epithelial cells, that is only piglets genetically expressing these receptors are susceptible to colonization of ETEC agent.



(2) Toxin Action: LT increase intracellular cyclic AMP levels, while STa and STb either upregulate cyclic GMP or directly activate chloride led to net loss of electrolytes and water, rapid dehydration and diarrhoea in newly weaned piglet.

(2) Weaning Stress and Gut Immaturity:

Weaning is a stressful condition for piglets that involve sudden separation from the sow, a newer environment, mixing with unfamiliar litters, and a shift to solid feed that led to rise in cortisol levels, which weakens the immune system. Additionally, it compromises the duodenal lining by disrupting the tight junctions between intestinal cells of small intestine. The stress also causes damage to the gut structure that led to decrease the size of the villi and overgrowth of the crypts, which significantly reduces the small intestinal ability to absorb nutrients.



(3) Dietary Changes and Nutritional Factors:

Switching from a sow milk to solid feed is one of the biggest challenges piglets faces during weaning time. Sow's milk is rich in easily digestible nutrients, whereas commercial feeds contain plant-based ingredients that are pose stress for young piglets to digest.

High levels of crude protein in the diet could also pose a problem. When piglets cannot fully digest this protein, it goes up in the lower part of the gut where it feeds by pathogenic bacteria like E. coli, enhance the risk of diarrhoea.

Poorly balanced diets, especially those with less in fiber that containing too much fat, can reduce the balance of gut bacteria and slow down digestion of feed

(4) other infectious cause: Although enterotoxigenic Escherichia coli is the main cause of post-weaning diarrhoea but other infectious agents can also cause this condition.

Viruses like **rotavirus and coronavirus mainly Porcine Epidemic Diarrhoea Virus (PEDV)** are also frequently involved. These viruses attack the cells lining of the small intestine that damage villi and decrease nutrient and fluid absorption.

Clostridium perfringens, a bacterium commonly present in the environment and piglet gut, can become problematic when the host immune system is very weak and also the intestinal barrier is also weak. It produces toxins that also harm the intestinal lining and that lead to diarrhoea.

(5) Environmental and Management Stress:

Another pathogen of concern is Salmonella spp. which can also affect piglets that are under stress or have a weakened immune system.

Environmental and management-related factors:

These factor played major role in the onset of post-weaning diarrhoea. Poor hygiene in pens create favourable conditions for the spread of harmful microbes.

Overcrowding is other common issue.

When too many piglets are placed in a limited space, it enhances competition for food and water, raises stress levels, and encourages aggressive behaviour like fighting, all of which weak activity of piglet immune system and make the gut more prone to post weaning diarrhoea.

Poor quality feed and unclean drinking water

can also introduce or support the growth of pathogens. Altogether, these stresses disrupt the overall health.

(6) Immune Status and Microbiota Imbalance:

After weaning, piglets face

a vulnerable period when their immune systems are still in developing phase, and their natural defences are not yet fully to handle pathogens. Before weaning, piglets depend mainly depend on maternal antibodies that passed through colostrum and milk of sow.

The sudden change in diet, combined with other environmental and social stress also causes a drop in beneficial bacteria such as Lactobacillus and Bifidobacterium, which normally help protect healthy gut.

Clinical Signs and Economic Impact

Clinical Signs of Post-Weaning Diarrhoea

1. **Typical onset:** Diarrhoea usually develops 3 to 10 days after weaning.
2. **Cumulative incidence:** In units not using medicinal zinc, 41.8 % (CI 33.6 to 50.4) to 51.1 % (CI 42.3 to 60.0) of piglet's experience at least one diarrhoea symptoms within the first 14 days post-weaning in host.
3. **Mortality rates:** Severe outbreaks can up to 15 to 20 % mortality among affected piglets in farm.
4. **Rapid onset of symptoms:** Seen 4 to 5 days after weaning, with watery faeces, dehydration, cold extremities, and lethargy in piglet.

Economic Impact

1. **Feed cost increase:** Affected farms report 7 to 9 % higher feed costs due to less expensive feed conversion ratio in recovering piglets.
2. **Low grade PWD losses:** Estimated at euro 40 per sow per year in herds experiencing subclinical or mild diarrhoea (data according to Europe).
3. **Increased antibiotic use:** Piglets with higher post weaning feed

intake need 2.38 more days of antibiotic treatment for diarrhoea in each batch.

Strategies to mitigate the PWD

PWD in piglets emerge from a combination of dietary, microbial, and physiological stress. Nutritional strategies can mitigate PWD by addressing these issues.

Protein Management: Decrease dietary crude protein (CP) to 15 to 18% and supplementing with essential amino acids like lysine, methionine, and threonine have a role to minimize undigested protein in the hindgut that limit substrates for pathogenic bacteria such as E. coli to colonize in small and large intestine and show significant clinical sign.

Acid-Binding Capacity (ABC): Choosing feed ingredients with low ABC helps maintain optimal gastric pH (around 3 to 4), increasing protein

digestion and inhibiting pathogen growth in gut.

Functional Additives: The use of organic acids (e.g., formic, lactic) that lowers gastric pH and suppresses harmful bacteria like ETEC strain. Enzymes such as phytase and xylanase also improve nutrient digestibility, while probiotics and prebiotics increase gut microbiota balance and mucosal integrity, reducing PWD incidence.

Feeding Strategies: Adding phase-feeding with gradual dietary transitions align with the piglets' developing digestive capacity and reduce gastrointestinal disturbances. Monitoring feed intake through automated systems that allows early detection of reduced consumption of feed that enable timely dietary adjustments to prevent PWD onset in piglet.

Strategy	Description
Low-Protein, Amino-Acid-Balanced Diets	Decrease crude protein to approximately 16 to 18% and supplement with crystalline lysine, methionine, and threonine to limit fermentable nitrogen in the hindgut and prevent ETEC proliferation.
Acidifiers & Organic Acids	Adding formic and lactic to lower gastric pH (to 3 to 4), increase pepsin activity, inhibit gram-negative pathogens and promote beneficial flora.
Exogenous Enzymes	Adding phytase, xylanase, protease to decrease intestinal viscosity, improve nutrient digestibility, decrease undigested protein flow and further lower diarrhoea severity.
Probiotics, Prebiotics Synbiotics	Administer probiotic strains like Lactobacillus spp. and Bacillus subtilis, along with substrates such as fructooligosaccharides or inulin and to competitively exclude pathogens, maintain beneficial microbiota and strengthen gut barrier function of piglet.
Phase-Feeding Programs	2 to 3 successive diets over the first 2 to 3 weeks of post-weaning each with gradually increase protein content and ingredient complexity to match the piglet's maturing digestive capacity and to avoid abnormal nutritional shifts.

Acid-Binding Capacity Control

Choosing feed ingredients with low acid-binding capacity, such as synthetic amino acids and highly digestible grains that helps to maintain optimal gastric pH.

Optimized Energy Density

Increasing highly digestible fats, like medium-chain triglycerides (MCTs) that ensures adequate energy intake even when feed intake dips post-weaning. This supports mucosal repair without causing osmotic overload in host.

Functional Feed Additives

Organic Acids: Adding organic acids (like formic, lactic) can also lower gut pH and inhibit gram-negative bacteria ETEC strain.

Exogenous Enzymes: Enzymes like phytase and xylanase decrease digesta viscosity and undigested protein flow, improving nutrient absorption in host;

Probiotics and Prebiotics: These support beneficial gut microbiota, increasing barrier integrity.

Phase-Feeding Programs

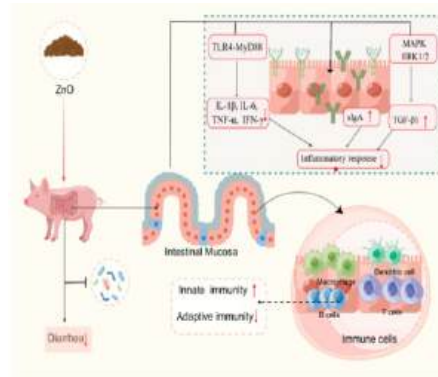
Implementing 2 to 3 successive diets over the first 2 to 3 weeks post-weaning, with successive increasing ingredient complexity and protein levels, aligns with the piglets developing digestive capacity and avoids abnormal nutrient shifts.

Mineral and Pharmacological Additives

Zinc Oxide and Alternatives

pharmacological levels of zinc oxide (ZnO) have been used to control PWD in piglet and environmental concerns led to its restriction in some regions. Alternatives include organic acids and other feed additives that show similarity with ZnO benefits without its drawbacks.

Copper and Phytogetic Feed Additives



Copper sulphate and phytogetic compounds (e.g., essential oils) also possess antimicrobial properties that is very important to host. Their inclusion in diets that can also help to manage gut health, but usage must be balanced to prevent resistance against ETEC strain.

Immunological Strategies

Vaccination Against ETEC

Vaccines that target ETEC strains, mainly those expressing F4 and F18 fimbriae, can reduce colonization and toxin production further lowering the incidence of PWD.

Passive Immunity

Giving diets with spray dried plasma or egg yolk antibodies provides passive immunity in host and enhance mucosal defences during the critical post-weaning period.

Environmental and Management Practices

Hygiene and Biosecurity

Implementing strict hygiene schedule, including thorough cleaning and disinfection of facilities that helps to reduce pathogen load and transmission in piglet.

Thermal Comfort and Ventilation

Maintain optimal and ambient temperatures (28 to 30°C) and ensuring proper ventilation reduces stress and also supports feed intake, both critical and preventing PWD.

Stocking Density and Housing Design

Appropriate stocking densities and well-designed housing system can minimize stress and disease transmission also contribute to better gut health.

Weaning Management

Gradual Weaning Techniques

Giving gradual weaning methods, such as two-stage weaning, can also ease the transition and reduce stress and lowering the risk of PWD.

Creep Feeding

Introducing solid feed during the lactation period helps early feed intake, promoting gut adaptation and smooth dietary transitions post-weaning.

Genetic Selection and Long-Term Resilience

ETEC-Receptor Negative Lines

Breeding pigs that do not have receptors for ETEC fimbriae (F4/F18) have innate resistance that significantly reduce the prevalence of PWD.

Selection for Stress Resilience

Selecting for traits that is associated with stress resilience, such as stable cortisol activity, increase piglets' ability to cope with weaning challenges.

Emerging Biocontrol and Alternative Approaches

Bacteriophage Therapy

Using bacteriophages that is specific to ETEC strains offers a targeted approach to reducing pathogenic E. coli. bacteria without disturbing beneficial microbiota.

Essential Oils & Phytochemicals

adding essential oils and phytochemicals (e.g., thymol, carvacrol) into diets gives antimicrobial and anti-inflammatory benefits that support gut health.

Nutritional Immunomodulators

Adding immunomodulatory nutrients like β-glucans, vitamin D, and selenium

can also express the immune system, increase resistance to PWD.

Monitoring and Early Intervention

Faecal Scoring and Biomarker Analysis

Need to Regular monitoring of faecal sample and biomarkers (like haptoglobin, cytokines) in piglets that helps in early detection of PWD that is very important for early intervention.

Farm-Level Integration and Protocol Development

Here, developing standard operating procedures (SOPs) that integrate nutrition, vaccination schedules, environmental controls, genetic selection, and monitoring protocols and also ensures prevention and rapid response to PWD outbreaks.

Antimicrobial Therapies

Antibiotics are mostly used to treat PWD, particularly when caused by enterotoxigenic *Escherichia coli* (ETEC). The selection of antibiotics should be based on the specific target pathogens involved and their antimicrobial susceptibility.

Immunoglobulin Supplementation

Supplementing piglet diets with immunoglobulin rich products like spray dried plasma, can increase passive immunity, improve healthy gut integrity and reduce diarrhoea incidence.

Natural Feed Additives

Using natural additives like essential oils and organic acids some other prebiotic and probiotics into piglet diets can also enhance healthy gut microbiome in piglet that is very important to manage PWD.

Nutritional Support

Ensure adequate Supply of essential nutrients such as β -glucans, vitamin D, and selenium could also increase the activity of immune system of piglet that cause enhance higher chance to resist against PWD. These important nutrients increase the activity of immune function and affect overall health of piglet.

Supportive Care

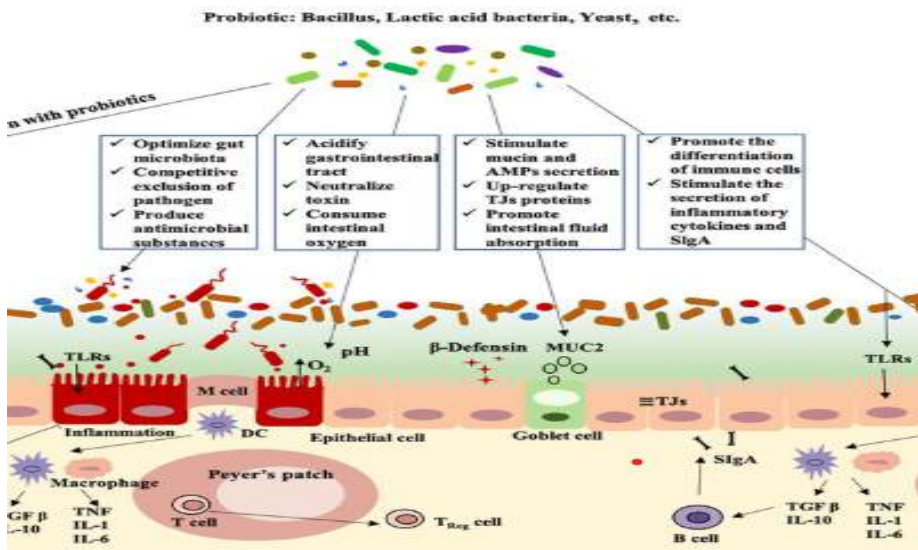
Ensuring piglets have access to a very clean water and giving optimal environmental conditions, such as optimum temperature and hygiene, can

decrease stress and may support recovery from PWD.

CONCLUSION

Post-weaning diarrhoea (PWD) poses a significant challenge in pig production, stemming from a combination of dietary changes, environmental stress and immature immune systems in piglets. The sudden transition from sow's milk to solid feed, exposed with exposure to pathogenic micro-organism like enterotoxigenic *Escherichia coli* (ETEC) that leads to gastrointestinal disturbances. With growing restrictions on antibiotics and zinc oxide due to resistance concerns, alternative strategies have become essential. Apply low-protein, amino acid-balanced diets, adding functional feed additives such as organic acids and probiotics, prebiotics, synbiotics and adopting gradual weaning practices can collectively enhance gut health and maintain resilience in piglets.

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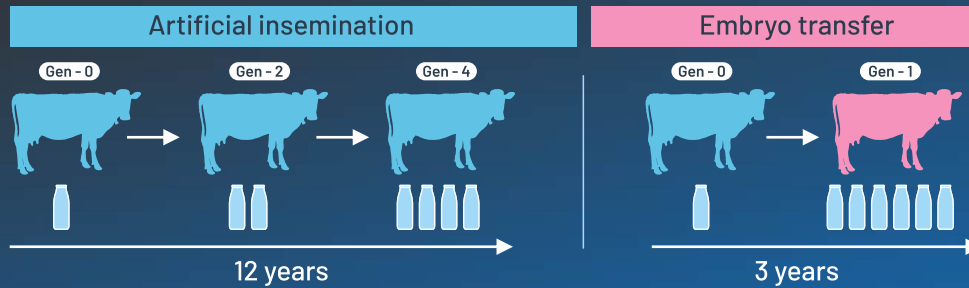
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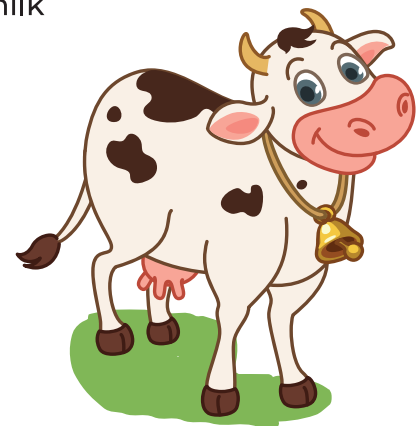


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$\cos 2x = \cos^2 x - \sin^2 x$
 $\frac{\partial z}{\partial x} = 2, \frac{\partial z}{\partial y} = 0 \quad \vec{n} = (F_x; F_y; F_z)$
 $z = \frac{1}{x} + \sin \frac{\sqrt{z}}{z}$
 $\sin(x+y) = \sin x \cos y + \cos x \sin y$
 $A = \begin{pmatrix} x & 4x^2 & 1 \\ y & 4y^2 & 1 \\ z & 4z^2 & 1 \end{pmatrix}; x=0, y=1, z=2$
 $A = [1; 0; 3]$
 $\sum_{i=0}^n (p_2(x_i) - y_i)^2$
 $\lim_{n \rightarrow \infty} \frac{\sqrt{n^3+1} + n}{3\sqrt[3]{n^2+2n-1}}$
 $z = i\sqrt{14}$
 $X_1 = \begin{pmatrix} \alpha + \beta + \gamma \\ \alpha \\ \beta \end{pmatrix}$
 $Y_{int} = Y_1 + b \cdot k_2 \cdot \tan x$
 $|z| = \sqrt{a^2 + b^2}$
 $\lim_{x \rightarrow 0} \frac{e^{2x} - 1}{5x} = \frac{2}{5}$
 $e^{-xy} z = e; A[0; e; 1]$
 $\sin^2 x + \cos^2 x = 1$
 $2 \arctan x - x = 0, I = (1, 10)$
 $\cos 2x = \cos^2 x - \sin^2 x \quad \delta(p_2) = \sqrt{0.16}$

Feed safety + Safe water + Healthy gut = Better Efficiencies
Better Efficiencies = PROFITS

$\cos \varphi = \frac{(1; 0) \cdot (\frac{1}{\sqrt{3}}; \frac{1}{4\sqrt{3}})}{\sqrt{\frac{1}{12} + \frac{1}{48}}}$
 $\eta_1 = \lambda_1^2 - 3\lambda_1 + 1 \neq 0$
 $2x^2 y y' + y^2 = 2$
 $a^2 = b^2 + c^2 - 2bc \cos \alpha$
 $\frac{\sin x}{x} \leq \frac{x}{x} = 1$
 $B = \begin{pmatrix} 2 & 1 & -1 & 0 \\ 3 & 0 & 1 & 2 \end{pmatrix}$
 $y = x^3$
 $y = x^2$
 $\frac{2x}{x^2 + 2y^2} = 2$
 $A + B + C = 8$
 $-3A - 7B + 2C = -10, 3$
 $-18A + 6B - 3C = 15$
 $C = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
 $|z| = \sqrt{a^2 + b^2}$
 $f(x) = 2^{-x} + 1, \epsilon = 0.005$
 $\tan x \cdot \cotg x = 1$
 $\sin(x+y) = \sin x \cos y + \cos x \sin y$
 $\int_{-\sqrt{2}}^{\sqrt{2}} \sin^4 x \cdot \cos^3 x \, dx$
 $\int 3x^2 + 16x^{-0.12} \, dx$
 $\lim_{h \rightarrow \infty} (1 + \frac{2}{h})^h$
 $x_1 = -11p, x_2 = -p, x_3 = 7p, p \in \mathbb{R}$
 $y = \sqrt[3]{x+1}, x = \tan t$
 $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 0$
 $y \left(\frac{\partial f}{\partial x} \right) = 16 - x^2 + 16y^2 - 4z > 0$

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