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58th Annual General Meeting (AGM)
&
66th National Symposium 2025

Souvenir

Theme
"Animal Agriculture in India - The Way Forward"

22nd & 23rd August 2025

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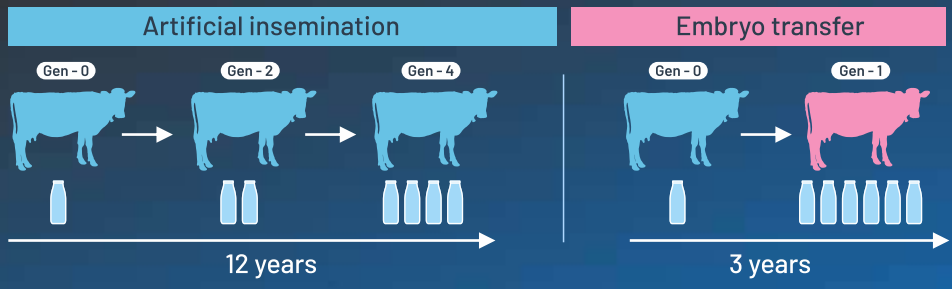

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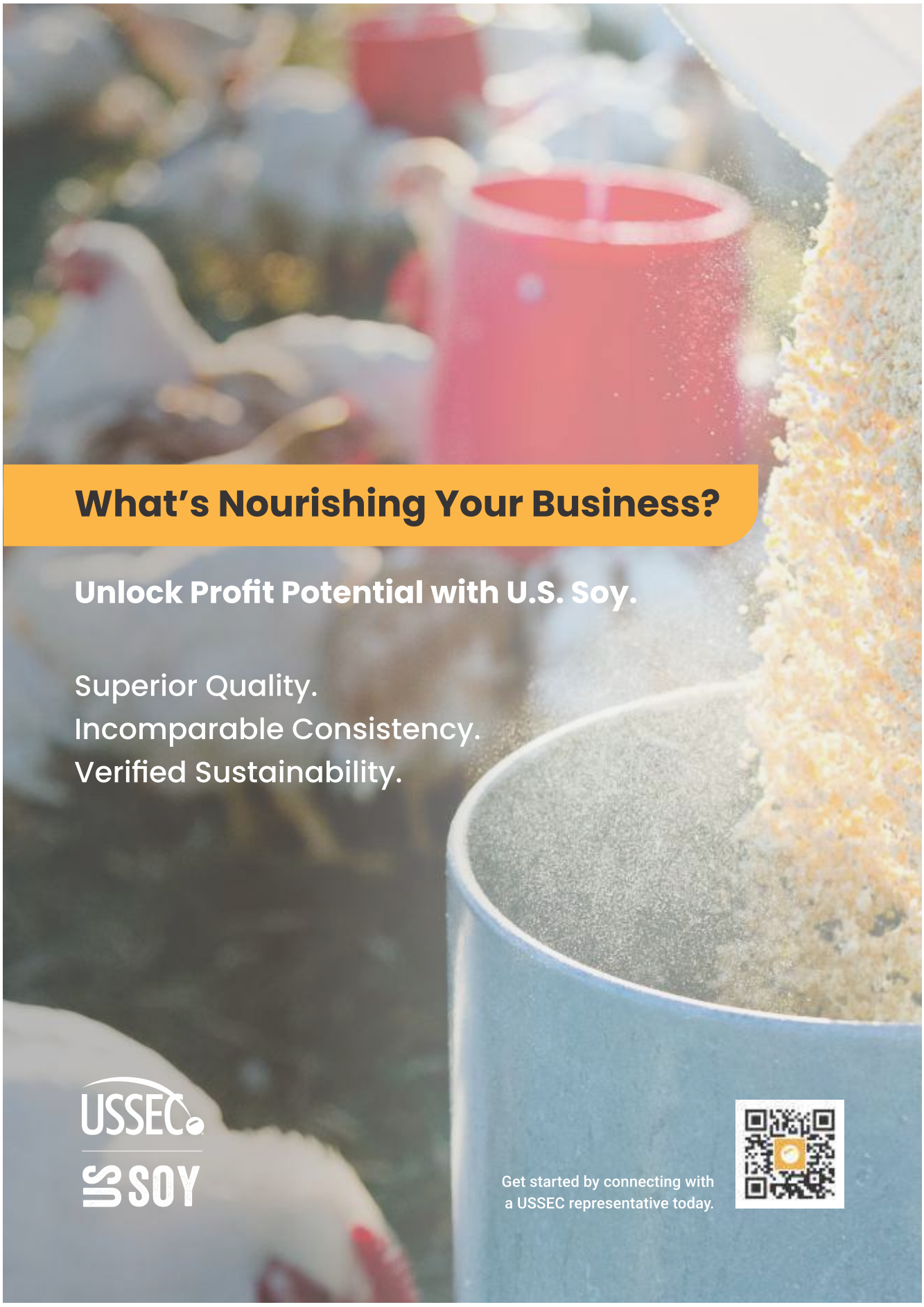
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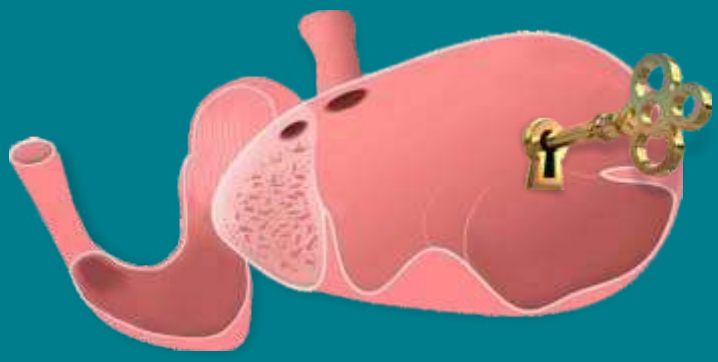

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MINISTER OF COMMERCE & INDUSTRY
GOVERNMENT OF INDIA

MESSAGE

I am delighted to learn that The Compound Livestock Feed Manufacturers Association of India (CLFMA) is organizing the 66th edition of the National Symposium from 22nd - 23rd August 2025, in Hyderabad, with the theme "Animal Agriculture in India - The Way Forward." A souvenir will also be published on this occasion.

It is truly commendable that CLFMA has consistently been at the forefront, promoting innovation and advocating for policies that contribute to the sustainable growth of the livestock sector. The addition of the CLFMA Students Program at this year's symposium is a significant step in bridging academia and the livestock sector, fostering new ideas and encouraging the next generation to engage in this critical industry.

This event will serve as an exceptional forum for networking, dialogue and collaboration among industry experts, researchers, policymakers and stakeholders. By bringing together key players from the livestock sector, it will foster an environment conducive to the exchange of innovative ideas and best practices. It will also address the sector's most pressing issues, from sustainable practices to technological advancements, and explore new ways to tackle the challenges and opportunities within the industry.

I congratulate CLFMA for organizing this symposium and with them success in all their future endeavors.

(Piyush Goyal)

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Prof. S. P. Singh Baghel
Minister of State
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and
Ministry of Panchayati Raj
Government of India

MESSAGE

I am pleased to extend my greetings to **CLFMA OF IINDIA** on the occasion of its **58th Annual General Meeting and the 66th National Symposium 2025.** This esteemed gathering serves as a vital platform for bringing together stakeholders from the livestock, aquaculture and allied sectors to deliberate on sustainable strategies for growth and resilience.

The theme for this year, **"Animal Agriculture in India - The Way Forward,"** aligns closely with the national vision of building a self-reliant and sustainable agri-food ecosystem. The fisheries and aquaculture sectors form integral pillars of this vision, contributing not only to nutritional security and export earnings but also to employment and income generation for millions in coastal and inland communities.

India stands among the leading fish-producing nations globally and the Department of Fisheries remains steadfast in its commitment to enhancing productivity, strengthening infrastructure, promoting value addition and advancing scientific aquaculture practices. Flagship initiatives such as the Pradhan Mantri Matsya Sampada Yojana (PMMSY) are transforming the sector into a modern, sustainable and inclusive driver of the rural economy.

I am confident that the deliberations at this Symposium will generate valuable insights, promote knowledge-sharing and foster collaborative approaches to strengthen the future of India's livestock and fisheries sectors. The Department of Fisheries reiterates its continued support in advancing a prosperous and resilient blue economy.

My heartfelt congratulations and best wishes to CLFMA OF INDIA for the successful conduct of this event.

(Prof. S. P. Singh Baghel)

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SRI VAKITI SRIHARI

THE HON'BLE MINISTER FOR ANIMAL HUSBANDRY AND FISHERIES, SPORTS AND YOUTH SERVICES, ANIMAL HUSBANDRY, DAIRY DEVELOPMENT AND FISHERIES DEPARTMENT

MESSAGE

I extend my warm greetings and congratulations to CLFMA OF INDIA on the occasion of its 58th Annual General Meeting and the 66th National Symposium 2025.

The theme of this year's symposium, **"Animal Agriculture in India – The Way Forward,"** is highly relevant and aligned with the national and state priorities of transforming the livestock and fisheries sectors into engines of rural prosperity, food security, and sustainable development.

In Telangana, Animal Husbandry and Fisheries have emerged as vital components of our rural economy. These sectors not only ensure year-round income for farmers and fishers but also enhance nutrition, livelihoods, and employment—especially for women and youth in marginalized communities. Our government remains committed to strengthening these sectors through infrastructure development, scientific innovation, and farmer-centric policies.

We are actively promoting integrated livestock and fisheries development models, modernizing veterinary care and disease control systems, expanding fodder cultivation, and supporting value chain enhancements through targeted schemes and financial incentives. In the fisheries sector, we are encouraging inland aquaculture, reservoir fisheries, and the adoption of sustainable practices to unlock the full potential of our water resources.

I appreciate CLFMA's consistent efforts in bringing together stakeholders from across the industry, academia, and policymaking institutions. The inclusion of the Students Program in this year's Symposium is a laudable step toward bridging the gap between knowledge and application, and for inspiring future leaders in animal agriculture.

Such platforms play a crucial role in fostering innovation, facilitating dialogue, and forging collaborations that will help address the sector's emerging challenges and unlock new opportunities for growth.

I wish the 66th National Symposium, 2025 great success and assure the continued support of the Government of Telangana in advancing the goals of a robust, inclusive, and sustainable livestock and fisheries sector.

(Vakiti Srihari)

Shrimp trade braces for uncertainty

SANJEEB MUKHERJEE
New Delhi, 30 July

India's shrimp sector was pushed into uncertainty following US President Donald Trump's decision to impose a 25 per cent tariff on all goods imported into the US from India.

Traders said India has been made to suffer due to its refusal to open up the dairy and agriculture sectors to cheap US imports. The US is the single-largest market for India's seafood export.

India exported almost $2.3 billion worth of shrimps to the US markets in FY24, which was more than 90 per cent of the total seafood exports to the US, trade data showed. Ecuador is India's biggest competitor in the US shrimp market and

quantity UK can import," Divya Kumar Gulati, chairman of Compound Livestock Feed Manufacturers Association (CLFMA), a body representing India's livestock sector told *Business Standard*.

Trump had, in April, announced 26 per cent tariffs on imports from India, which had plunged the sector into turmoil. The decision was later pa

Business Standard

(₹879 crore), with ug $80 million (77 e in the UK's $5.4 billion seafood import market is just 2.25 per cent.

"With CETA now in force, industry estimates project a 70 per cent surge in marine exports to the UK in the coming years," a government statement said a few days back.

t said note it Notwithstanding the hedge from markets, there would be major impact on d exports due to the tariffs, which would be d in share prices of firms dealing in sea- morrow.

EXPLAINED ECONOMICS

Fuel vs feed debate in maize

Diversion of maize for biofuel has turned India from a surplus producer and exporter to an importer of the feed grain. There is pressure now to even allow imports of genetically modified maize for ethanol production

The Indian EXPRESS

Growing use of DDGS will not be a threat to oilmeal sector, says CLFMA

businessline.

Shrimp traders fear $1 bn loss as long-term US contracts face heat

SHRINKING PROSPECTS

Business Standard

Feed makers see maize production rising 5-10 per cent on higher area

businessline.

CLFMA holds strategic seminar on Current Challenges in Poultry sector

The Compound Livestock Feed Manufacturers Association (CLFMA) of India, in collaboration with the U.S. Grains Council and with support from the Bihar Poultry Farmers Association (BPFA), hosted a seminar in Patna. The seminar, themed "Poultry in India: Current Challenges & the Way Forward," AgroSpectrum manufacturers, poultry farmers, ain suppliers, and researchers from across the region. The seminar successfully highlighted critical issues facing India's poultry industry, from volatile

Cotton may lose ground to maize in Central India this kharif season

businessline.

Feeding Future: The Role of Animal Nutrition in Building a Viksit Bharat

WORLD

CLFMA rolls out awareness drive to boost poultry, shrimp offtake

Vishwanath Kulkarni
businessline.
hydrate and cholesterol

Despite record output, India was a net importer of maize in 2024-25

businessline.

Maize acreage heading towards new high

AREA EXPANSION. Coverage up 15% till July 21; farmers plant more to cater to high demand from feed and ethanol makers

businessline.

"Poultry exporters face challenges with outdated refrigeration"

UK FTA, Maldives MoU shot in arm for marine sector

Industry estimates project a 70% surge in exports to the UK; Male pact to boost joint investments

Big catch

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FoodBeverageNews

बिज़नेस स्टैंडर्ड

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MESSAGE

India's animal agriculture sector is at a transformative juncture. With a livestock population of 536 million, commanding a 30% share in India's agriculture output and allied Gross Value Added (GVA), this sector is a powerhouse of rural employment, nutritional security and economic resilience. In this context, the event "66th National Symposium" and 22nd and 23rd August, 2025 and the theme chosen "Animal Agriculture in India - The Way Forward" organized by CLFMA of India needs special focus.

Despite the advancement, challenges such as disease outbreaks, fodder shortages, and infrastructure gaps persist in the sector. A way forward involves enhancing productivity through genetic improvement and better resource management, strengthening disease surveillance and control, improving market linkages and infrastructure, promoting public-private partnerships and focusing on sustainable practices.

Guided by the vision of self-reliance and sustainable development, the Government of India has launched flagship programs like National Animal Disease Control Program (NADCP) and Animal Husbandry Infrastructure Development Fund (AHIDF). The revised scheme of National Livestock Mission (NLM) aims towards employment generation, entrepreneurship development, increase in per animal productivity and thus targeting increased production of meat, goat milk, egg and wool under the umbrella scheme Development Program. Besides, the Rashtriya Gokul Mission (RGM) is being implemented since December 2014 for development and conservation of indigenous bovine breeds is an important scheme in enhancing milk production and productivity of bovines to meet growing demand of milk and making dairying more remunerative to the rural farmers of the country.

CLFMA has been always in the forefront to intervene and notify feed related issues to the Government of India. I appreciate & acknowledge the dedicated endeavors of CLFMA for holistic advancement of Livestock & Agriculture Sector.

I believe that the 66th National Symposium of CLFMA brings about suggestions & proposals for the overall development of the sector. On this occasion, I wish CLFMA's National Symposium a grand success.

(Alka Upadhyaya)

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SABYASACHI GHOSH, I.A.S
Special Chief Secretary to Government

Animal Husbandry, Dairy Development &
Fisheries Department,
Government of Telangana

Date: 11.08.2025.

MESSAGE

Telangana has emerged as one of India's leaders in livestock development, demonstrating how innovation, farmer-centric policies, and sustainability can transform rural livelihoods. I am pleased to extend my warm greetings to CLFMA of India on its 58th Annual General Meeting and the 66th National Symposium 2025.

The theme "*Animal Agriculture in India - The Way Forward*" resonates strongly with Telangana's vision of a vibrant, self-reliant, and sustainable livestock sector that uplifts farmers and strengthens rural economies. In our State, animal husbandry is not just an allied activity-it is a lifeline for thousands of small and marginal farmers, providing steady income, nutritional security, and resilience against climate-related challenges.

The Government of Telangana has been proactive in implementing transformative programmes such as with mobile veterinary units for doorstep service, state-wide vaccination drives under NADCP to ensure livestock health, sex-sorted artificial insemination initiatives, and animal health care systems. We have strengthened Dairy Farmer Producer Organizations to improve collective capacity, expanded milk chilling and cold chain facilities, promoted fodder development and silage making, and adopted digital livestock tracking for better management and traceability.

In addition, the State is investing in modern abattoirs, value addition in dairy and meat products, climate-resilient practices, and women's empowerment initiatives in animal husbandry. These efforts are aimed at improving productivity, expanding market access, and ensuring fair returns to farmers.

I appreciate CLFMA's inclusion of a Students' Programme in this year's symposium, as linking academia with industry is key to fostering innovation and nurturing future leaders in the livestock sector.

I am confident that the deliberations of this symposium will generate new ideas, partnerships, and strategies that will contribute to the continued growth of Telangana's livestock sector and the prosperity of our farming communities.

(SABYASACHI GHOSH)

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05 July 2025

Ruud Tijssens
Chairman
International Feed Industry Federation

MESSAGE

Dear Mr. Gulati,

On behalf of the International Feed Industry Federation (IFIF) I would like to thank you for your kind invitation to the inaugural session of your 66th National Symposium on 22-23 August 2025.

Unfortunately, neither the IFIF Chairman nor the Executive Director is available to join due to prior commitments. It would have been an honor for us to attend and join you and our Indian Feed Industry colleagues for this special occasion.

The theme of your Symposium *"Animal Agriculture in India - The Way Forward"* is of great relevance, particularly in a key livestock-producing country such as India. IFIF appreciates the support and strong collaboration with CLFMA OF INDIA. By working together, we can further grow and strengthen the global feed industry to promote and support sustainable, safe, nutritious and affordable food for a growing world population.

IFIF represents over 80% of the global animal feed production. We work closely with our members and collaboratively with the global agricultural value chain to address key issues, including feed and food safety, sustainability and good production practices. Our goal is to ensure high standards of health and welfare for animals and people and meet the many challenges ahead for the global feed & food chain.

Please do not hesitate to contact me or Alexandra de Athayde, IFIF Executive Director, should you have any questions. On behalf of the IFIF Board of Directors I wish you successful deliberations and fruitful discussions at your 66th National Symposium.

Sincerely,

Ruud Tijssens
Chairman
International Feed Industry Federation

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NICOLÒ CINOTTI
Secretary General
International Poultry Council

MESSAGE

On behalf of the International Poultry Council (IPC), it is a privilege to extend our warm greetings to all stakeholders gathered for the 66th National Symposium of the Compound Feed Manufacturers Association (CLFMA) of India. As we focus on the theme, "Animal Agriculture in India - The Way Forward," it is an opportune moment to reflect on the significant progress the livestock sector has made in India and to explore the future of animal agriculture, particularly poultry, in advancing global food systems.

The IPC, as the unified voice of the global poultry sector, recognizes the critical role that animal agriculture plays in feeding the world's growing population. Poultry, in particular, is uniquely positioned to lead the way in addressing the global challenges of food security, sustainability, and nutrition. As a sector that produces safe, affordable, and nutritious food at scale, we have the opportunity to demonstrate leadership within our global food system.

The CLFMA's commitment to fostering dialogue, innovation, and advocacy through seminars across India is invaluable. These efforts contribute not only to the growth of India's livestock sector but also to its global integration. As we work towards a more sustainable and efficient food system, it is essential that we continue to share knowledge, collaborate on best practices, and advocate for policies that support animal welfare, enhanced productivity, and the adoption of advanced technologies.

The Symposium is a vital platform where experts, policymakers, and industry leaders from across India and abroad will come together to discuss the pressing issues and opportunities facing the livestock sector. As an organization that represents the entire poultry value chain we understand the importance of collective action in shaping a sustainable and prosperous future for animal agriculture.

We commend CLFMA for its unwavering dedication to advancing the livestock sector through insightful discussions and strategic partnerships. The IPC looks forward to continuing our collaboration with CLFMA and all other stakeholders to ensure that the animal agriculture sector remains resilient, innovative, and globally competitive.

We are confident that the outcomes of this symposium will contribute to meaningful progress in the sector, not only in India but also on the global stage. Let us continue working together to achieve our shared vision of a sustainable, efficient, and inclusive food system that benefits all.

NICOLÒ CINOTTI
Secretary General
International Poultry Council

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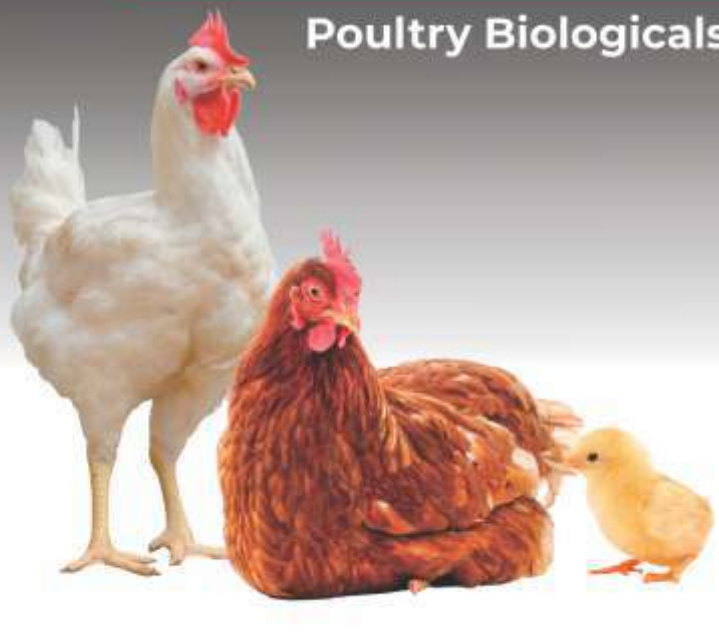

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Convenor Address

It is a matter of great honour and joy to welcome all our esteemed guests, speakers, and delegates to the 58th Annual General Meeting and the 66th National Symposium of CLFMA OF INDIA, scheduled to be held on the 22nd and 23rd of August, 2025 at the iconic Taj Deccan, Hyderabad.

We are truly privileged to host a diverse and distinguished gathering of policymakers, scientists, technocrats, industry leaders, and entrepreneurs from across India and overseas.

Your presence reaffirms the significance of this forum and strengthens our collective resolve to shape the future of India's animal agriculture sector.

India's livestock industry is undergoing a remarkable transformation. As we aim for a developed and resilient economy by 2047, the role of animal agriculture—as a driver of nutritional security, rural income, employment, and inclusive growth—becomes even more critical. The sector's contribution to GDP, its deep rural outreach, and its potential for innovation make it one of the cornerstones of India's agrarian future.

However, the path forward is not without challenges. Climate variability, feed and fodder constraints, disease outbreaks, rising input costs, and evolving consumer demands require a coordinated and forward-thinking approach. At the same time, new frontiers—ranging from precision livestock farming and circular bio-economy models to AI-driven health diagnostics and sustainable feed formulations—are opening up exciting opportunities.

The Theme of 66th National Symposium, **"Animal Agriculture in India – The Way Forward,"** seeks to spotlight these challenges while also providing a roadmap for transformation. Through insightful discussions, expert sessions, and interactive panels, we aim to explore strategic directions including:

- Integrating technology and digital solutions for improved productivity and traceability
- Strengthening value chains across dairy, poultry, aquaculture, and small ruminants
- Promoting climate-smart and regenerative farming practices
- Encouraging policy reforms, capacity building, and entrepreneurship, especially among women and youth

We also gratefully acknowledge the progressive policy ecosystem created by the Government of India, with landmark initiatives such as the Rashtriya Gokul Mission, National Livestock Mission, Pradhan Mantri Matsya Sampada Yojana, and the Animal Husbandry Infrastructure Development Fund, which are helping propel the sector forward with purpose and vision.

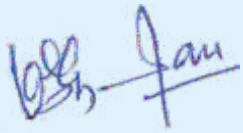
At CLFMA OF INDIA, we remain deeply committed to facilitating dialogue, fostering collaboration, and supporting evidence-based policy-making. This Symposium is yet another step in that direction—a platform to connect, learn, ideate, and co-create actionable strategies for the road ahead.

I extend my heartfelt thanks to our Chief Guest, Guests of Honour, Sponsors, Speakers, Government Partners, Foreign & other dignitaries related to Livestock Sector for their enduring support to CLFMA OF INDIA as always.

We look forward to two days of meaningful deliberations, knowledge exchange, and impactful networking in the vibrant city of Hyderabad.

Let us join hands to shape a resilient and thriving future for the livestock sector.

With Regards,



Vijay D. Bhandare
Convenor of 66th National Symposium 2025
CLFMA OF INDIA

Chairman's Address

It is with immense pleasure and pride that I welcome you all to the CLFMA OF INDIA's 58th Annual General Meeting and 66th National Symposium, 2025 scheduled to be held on the 22nd and 23rd August, 2025 at the Taj Deccan, Road No. 1, Banjara Hills, Hyderabad – 500 034.

On behalf of the entire CLFMA fraternity, I extend our heartfelt gratitude to our **Chief Guest, Guests of Honour,** distinguished dignitaries, renowned speakers, government officials, industry leaders, and delegates from across India and abroad. Your esteemed presence here today reaffirms the relevance and importance of this platform and enriches our collective dialogue.

The theme of this year's symposium, **"Animal Agriculture in India – The Way Forward,"** is both timely and consequential. India's livestock sector, which contributes over **4% to the national GDP** and supports the livelihoods of over **100 million rural households**, is at a pivotal juncture. With India being one of the world's largest producers of milk, eggs, and meat, this is a defining moment to chart the future course of animal agriculture in the country. As we envision India's journey towards **Amrit Kaal 2047**, a sustainable, inclusive, and globally competitive livestock sector will play a central role in achieving our national developmental goals.

In line with our commitment to nurturing the next generation of livestock professionals, I am pleased to announce the launch of the **CLFMA Students Program** at this year's symposium. This unique initiative invites students across the country to present research projects addressing real-world challenges in poultry, dairy, swine, and aquaculture sectors. Shortlisted entries, evaluated by a panel of experts, will be awarded **cash prizes and certificates**, and more importantly, will receive the opportunity to engage directly with industry leaders—creating pathways for **youth involvement and innovation in animal agriculture**.

The theme **"Animal Agriculture in India – The Way Forward"** aims to highlight the path towards a **future-ready livestock sector** — one that embraces **innovation, technology adoption, policy support, and responsible practices.** This includes:

- Strengthening value chains across **dairy, poultry, fisheries, and small ruminants**
- Adoption of **digital tools, genomics, precision nutrition**, and **climate-smart practices**
- Encouraging **public-private partnerships,** infrastructure investment, and **scientific R&D**
- Empowering **women and youth,** promoting **entrepreneurship**, and ensuring inclusive growth

CLFMA remains steadfast in championing the interests of livestock farmers and sector players by promoting sustainable practices, facilitating knowledge exchange, and supporting policies that strengthen India's livestock economy. Our efforts focus on enhancing productivity, animal health and

welfare, food safety, and the adoption of advanced technologies to meet evolving consumer and market demands, through various **seminars and farmers' orientation programs.**

CLFMA of India continues to work proactively with policymakers to align industry objectives with national priorities. In this direction, we have proposed the establishment of:

- **Export Oriented Zones (EOZs)**
- **Livestock Export & Domestic Development Authority**

These strategic bodies will significantly enhance ease of doing business and boost the global competitiveness of the Indian poultry sector by ensuring:

- Access to **raw materials at global price parity**
- **A simplified regulatory framework** for domestic and international trade
- **Market creation and diversification** through government-to-government collaboration and coordinated branding strategies through FTA

The Government of India has taken commendable strides to support the sector. Initiatives like the **National Dairy Plan, Rashtriya Gokul Mission, Poultry Venture Capital Fund, Animal Husbandry Infrastructure Development Fund, Pradhan Mantri Matsya Sampada Yojana**, and the **Blue Revolution**, among others, are paving the way for sectoral growth and sustainability.

At CLFMA of India, we remain steadfast in our commitment to aligning industry aspirations with the nation's developmental vision. This Symposium serves as a dynamic platform, a melting pot of ideas, where synergies are discovered, best practices are exchanged, and innovation is championed to propel India's livestock sector beyond global benchmarks.

As we convene here in Hyderabad, I am confident that the **66th National Symposium, 2025** will serve as a catalyst for new partnerships, breakthrough ideas, and actionable strategies to shape a robust and future-ready livestock ecosystem.

I would like to sincerely thank our **Sponsors, Office Bearers, Managing Committee Members**, and all CLFMA members and delegates for their unwavering support and dedication to our shared mission.

Together, let us seize this opportunity to **deliberate, collaborate, and innovate**—to drive forward the vision of a vibrant animal agriculture sector that contributes to **national prosperity, nutritional security,** and **global leadership.**

With Regards,

Divya Kumar Gulati
Chairman
CLFMA OF INDIA

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PROGRAMME

CLFMA 58th AGM & 66th National Symposium 2025

22nd & 23rd August 2025

Taj Deccan, Road No. 1,
Banjara Hills, Hyderabad - 500034.

"Animal Agriculture in India - The Way Forward"

Day-1: Friday, August 22, 2025

Time	Session
10:00 hrs	Registration of Delegates
11:00 hrs - 12:00 hrs	Managing Committee Meeting
12:00 hrs - 13:30 hrs	Lunch
13:30 hrs - 14:30 hrs	58th Annual General Meeting
	Inaugural Session
16:00 hrs	**Inviting Dignitaries to the Dais inauguration & Lighting of Lamp**
16:05 hrs	**Welcome Address by Convenor Mr. Vijay D. Bhandare**, Managing Committee Member, CLFMA OF INDIA
16:10 hrs	**Chairman Address by** Mr. Divya Kumar Gulati, CLFMA OF INDIA
16:15 hrs	**Thematic Address by** Shri. Tarun Shridhar, IAS, (Retd.) - Animal Agriculture: Setting the Context
16:30 hrs	CLFMA Awards & Students Awards Ceremony
17:15 hrs	**Address by Special Guest** Sri Sabyasachi Ghosh, IAS, Special Chief Secretary, Government of Telangana
17:25 hrs	**Address by Guest of Honour,** Ms. Alka Upadhyaya, IAS, Secretary AHD, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India
17:35 hrs	**Address by Guest of Honour** - Sri Vakiti Srihari, Minister for Animal Husbandry and Fisheries, Sports and Youth Services, Animal Husbandry, Dairy Development and Fisheries Department, Hyderabad, Telangana
17:45 hrs	**Address by Chief Guest,** Prof. S. P. Singh Baghel, Minister of State of Fisheries, Animal Husbandry & Dairying and Minister of State in the Ministry of Panchayati Raj
17:55 hrs	**Launching Souvenir**
18:00 hrs	**Vote of Thanks by** Mr. Nissar F. Mohammed, Honorary Secretary, CLFMA OF INDIA
19:00 hrs	**Networking Dinner & Live Performance** Felicitation of Sponsors, Media, Guests and Invitees

Day-2: Saturday, August 23, 2025

09:00 hrs	Registration
09:15 hrs	Welcome Address by Mr. Divya Kumar Gulati, Chairman, CLFMA OF INDIA
09:30 hrs	Introduction of Symposium – Dr. Devender Hooda, CLFMA OF INDIA
10:00 hrs	**Dr. R. S. Sodhi,** President, Indian Dairy Association - Growing Towards a Globally Competitive **Dairy**
10:20 hrs	**Dr. Girish Kolwankar**, Director, Premium Chick Feeds Pvt. Ltd. - Managing Emerging Challenges and Harnessing Opportunities in **Poultry**
10:40 hrs	**Dr. Manoj M. Sharma**, Director, Mayank Aqua Products - **Aquaculture**: Looking Beyond Exports and Expanding Domestic Markets
11:00 hrs	**Panel discussions: Feed, Raw materials and Other Inputs– Balancing the Balance Sheet** **Moderator: Dr. O. P. Chaudhary (Retd. JS NLM/PC)** • Mr. R. Ramkutty, Broiler Coordination Committee (BCC) • Dr. R. S. Masali, Associate Vice President – Nutrition, Godrej Agrovet Ltd. • Mr. Amit Sachdev, Techpro India • Dr. P. S. Mahesh, Joint Commissioner and Director, CEAH-Bengaluru • Dr. N. C. Manju, Animal Nutritionist • Dr. Gagan Garg, Deputy Commissioner (Trade), Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India • Representative from GEMA*
13:00 hrs – 14:00 hrs	**Lunch Break**
14:00 hrs	Right to Protein initiative USSEC
14:15 hrs	**Panel Discussions with National Associations**
	Outlook of Animal Agriculture for Viksit Bharat **Moderator: Shri. Tarun Shridhar, IAS, (Retd.)** • Mr. Suresh Chitturi, Vice Chairman, All India Poultry Breeders Association • Mr. Divya Kumar Gulati, Chairman, CLFMA OF INDIA • Mr. Ranpal Dhanda, President, Poultry Federation of India • Mr. Daljit Singh, President, Progressive Dairy Farmers Association • Mr. Saji Chacko, President, Society for Aquaculture Professionals (SAP) • Mr. Ravi Kumar Yellanki, President, All India Shrimp Hatchery Association • Mr. Madan Mohan Maity, General Secretary, West Bengal Poultry Federation Association • Mr. Uday Singh Bayas, President, Indian Poultry Equipment Manufacturers Association
15:30 hrs	**Animal Agriculture: Health Challenges & Potential Solutions** **Moderator: Dr. P. K. Shukla (Head of Department, Mathura Veterinary College)** • Poultry Health: Dr. M. R. Reddy (General Secretary Association of Avian Health) Professions, Principal Scientist Project Directorate of Research Options. • Poultry Health: Dr. Ajay Deshpande, President, Vets In Poultry (VIP) • Dairy Heath: Dr. Mukesh Sharma, Dairy Consultant • Dr. Shirish Nigam, President, Indian Federation of Animal Health Companies (INFAH)
16:45 hrs	**Valedictory Session: Mr. Abhay Shah, Dy. Chairman CLFMA OF INDIA**
	Felicitation of Sponsors, Media, Guests and Invitees
	Vote of Thanks by – Mr. R. Ramkutty, Treasurer, CLFMA OF INDIA
19:00 hrs	**Networking Dinner**

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CLFMA Lifetime Achievement Award

MR. PRAVIN SURAJMAL LUNKAD

Name	:	**PRAVIN SURAJMAL LUNKAD**
Date of Birth	:	13th December,1955.
Address	:	"Suraj Mansion", Opposite Chonde Dam SR NO. / GAT No. 385 , Pune –Bhugaon–412115
E-mail ID	:	pslunkad@gmail.com
Attended Modern High School	:	From 1961 to 1972
Educational Qualification	:	B.COM ,DBM (From BMCC Collage, Pune)
Occupation	:	Business : Experience:In Agro Processing industry& International business for more than 47 years.
Factories Locations & engage in Agro Processing & Bio Chemicals.	:	**Nav Maharashtra group of Industries** 1) In Maharashtra Sangli Sholapur Shirwal (Satara) 2) Mumbai Churchgate– Office for International Business & Trading operations
SOCIAL ACTIVITIES & RESPONSIBILITIES	:	Active in many State and National Level Chamber of Commerce related to Agri Processing. 1) **Past President** - The Compound Livestock Feed Mfgrs. Association of India., Mumbai 2) **Past President-** Solvent Extraction Association of India., Mumbai. 3) **Founder & - President Emeritus** Krishna Valley Chamber of Commerce and Industries, Sangli.

4) **Founder & President -** Krishna Valley Club, Sangli.

5) **Founder & President -** Rotary Club of Krishna Valley, Sangli.

6) **Founder Trustee -** Krishna Valley Advance Agricultural Foundation (Leading Agri Foundation for advance AgriEntreprenure Training)., Sangli

7) **Founder Trustee -** Suraj Foundation – running schools in rural Maharashtra, BPO centre at Sangli.

8) **Founder Trustee -** SurajLalitkala Academy Sangli.

9) **Member & Trustee -** Dharma Mangal Jain Vidyapeeth, Madhuban (Jharkhand)

10) **Founder & Trustee -** Suraj Sports Academy, Sangli.

11) **Member** - JITO (Jain International Trade Organization, Mumbai)

<u>Trustee & active member of various Charitable organizations such as Primary Education, higher Education, Sports Academy, Women Welfare activities in Rural Maharashtra, Cultural activities</u>

1) **Trustee -** Shree Jain VidyaPrasarak Mandal, Chinchwad, Pune.

2) **Trustee -** Investment in Man Trust , Pune (for Child & Women Development).

3) **Trustee -** Dr. Shripati Shastre Research Institute of Social Sciences conducted by Samshodhan DnyanVichar Pratisthan, C/o Sahnishta Society, Sahakar Nagar Parvati , Pune 411009., headed by Dr. Sharad Khare.

,

4) **Managing Committee - Member** Nisarg Prathisthan /Nature Foundation, 1st floor, Dr. Deshpande Smriti Mandir, High School Road, Sangli.

5) **Managing Committee -** Member Shree Vardhaman Shwetambar-Sthanakwasi Jain Shravak Sangh Sadhana Sadan, 259/2, Nana Path, Pune -411042

6) **President -** Maharashtra State Table Tennis Association.

7) **Trustee -** Latthe Education Society, Sangli (Spread across South India)

ACHIEVEMENTS	:	School National Player for Basket Ball for 1972. First 100% indigenous Development of Expander Technology at Chennai (Engg.Unit) for Oil Industries. First to develop Poultry Feed without animal Protein in the year 1988. Recipient of Award for Highest exporter of KokamFat in India consequently for 5 years. Recipient of Late Sachin Vyas Krida Prize for the Best working in the field of sports. Successful establishment of Local BPO at Sangli.
Seminars & conference	:	Attended more than 100 Seminars and Conferences all over world.
Abroad Visits	:	Travelled all over world on various business & Social Assignments & visited for more than 50 countries.
Hobbies	:	1. Sports and encouraging sports and watching sports events. 2. Reading Books. 3. Travelling and exploring new opportunities.
Marital Status & Family Information.	:	Married to Mrs. Aruna Lunkad . Have 3 daughters. All of them are married.

CLFMA Award

Dr. K. Karthikeyan
B.V.Sc., M.V.Sc.
Veterinary Consultant – Poultry Industry Specialist
Experience: 58 Years | Poultry Expertise | Industry Mentor

Dr. K. Karthikeyan is a veteran veterinary professional with over **five decades of experience** in the field of **poultry science and veterinary practice**. A graduate and post-graduate from **Madras Veterinary College** (B.V.Sc. – 1967, M.V.Sc. – 1970), he has played a vital role in shaping the poultry industry in **Tamil Nadu, Kerala**, and **Karnataka** through his technical leadership and field expertise.

With a strong foundation in both government and private sectors, Dr. Karthikeyan has successfully contributed as a **Veterinary Surgeon, Assistant Manager, Industry Specialist, and Independent Consultant**. His work has empowered countless poultry entrepreneurs, farm owners, and integrators across South India.

Education :

- **B.V.Sc.**, Madras Veterinary College – 1967
- **M.V.Sc.**, Madras Veterinary College – 1970 (Specialized in Poultry Science)

Career Highlights

- **Veterinary Association Surgeon**, Animal Husbandry Department (1967–1978)
- **Assistant Manager,** Poultry Development Corporation, Tamil Nadu (1978–1980)
- Worked with leading feed companies:
    - **Shaw Wallace Pvt Ltd**
    - **SKM Animal Feeds**
- Senior roles in premier breeder hatcheries:
    - **Midhunapur Hatcheries** – Kolkata
    - **C&M Hatcheries** – Nashik
    - **Kohinoor Hatcheries** – Hyderabad
    - **Unikay Hatcheries** – Coimbatore
    - **A A Farms** – Coimbatore

Independent Poultry Consultant (Since 1996)

Dr. Karthikeyan transitioned into a consulting role in 1996 and has since been a trusted advisor for numerous large-scale poultry enterprises and breeding farms:

Tamil Nadu:

- **Suguna Farms**
- **Shanthi Poultry Farms**
- **MBS Hatcheries**
- **Valarmathi Hatcheries**
- **RMP Hatcheries**
- **Swami Hatcheries**
- **Mani Hatcheries**
- **Sun India Hatcheries**

Kerala:

- **Kozhikode Poultry Farms**, Pala
- **Sanjo Breeding Farms**, Muvattupuzha
- **Star Animal Feeds**, Angamaly
- **Vinayaka Feeds**, Perumbavoor

Karnataka:

- **Diamond Hatcheries**, Bangalore
- **Souza Hatcheries**, Hasan
- **Nandhini Poultry breeding farm**, Kolar

Awards & Recognition

- **PRISM Award** from **Venkateshwara Hatcheries** – for outstanding contribution to the poultry industry.

Impact & Legacy

- Dr. Karthikeyan has **travelled extensively across Kerala**, supporting integrators and new entrants in setting up successful poultry ventures. His technical guidance, decades of experience, and deep understanding of poultry genetics and feed management have earned him a revered position in the Indian poultry sector.
- He continues to serve as a **mentor and industry advisor**, actively shaping the next generation of poultry professionals and farm entrepreneurs.

CLFMA Award

Prof. Jyoti Palod
Department of LPM
CVASc, GBPUAT
Pantnagar, Uttarakhand

Professor Jyoti Palod is an academician, researcher, and a revered mentor in the field of Animal Nutrition, Livestock Production Management, and Poultry. She completed her B.V.Sc. & A.H. and M.V.Sc. & A.H. in Animal Nutrition and Feed Technology, both with first division, from the prestigious College of Veterinary Sciences and Animal Husbandry, Mhow, Madhya Pradesh, and was awarded ICAR Junior Research Fellowship for her postgraduate studies. She completed her Ph.D. in Animal Nutrition from DUVASU, Mathura. With over 30 years of professional experience, she is serving as Professor for more than 15 and a half years. She is a Fellow of the National Academy of Veterinary Sciences, Fellow of Indian Poultry Science Association, Fellow of Animal Nutrition Association, and Fellow of Indian Society of Animal Production and Management. Under her guidance, one M.V.Sc. student received the prestigious Bharat Ratna Pt. Govind Ballabh Pant Gold Medal Award. Professor Palod currently serves as a Governing Council Member of the National Academy of Veterinary Sciences, Executive Council Member of the Indian Association of Women Veterinarians, and Joint Treasurer of the Animal Nutrition Association.

She has successfully led multiple ICAR and university funded, as well as field oriented, research projects. Her academic output includes 155 research papers published in reputed national and international journals, 6 manuals, 3 books, 20 book chapters, and 13 booklets/folders. With more than 200 popular articles published in both Hindi and English, she has played a vital role in connecting cutting edge research with the needs of livestock farmers. She has guided 3 Ph.D. and 11 postgraduate scholars, and contributed as advisory committee member for over 60 PG and PhD students. She served as an editorial board member of 17 reputed journals and magazines, and has been the recipient of 20 distinguished awards from various professional organizations.

Dr. Rupinder Singh Sodhi
President
Indian Dairy Association (IDA)

Dr. Rupinder Singh Sodhi is the President of Indian Dairy Association (IDA), established in the year 1948, and is an apex body of dairy industry professionals, planners, milk producers, research scientists and academicians. The members are from cooperatives, corporate bodies, multi-national companies, private, government and public sector enterprises. IDA takes part in advocacy with Govt. bodies in planning process and promotes the dairy development programmes and the policies of the State and Central governments.

Dr. Sodhi was the Managing Director of Gujarat Cooperative Milk Marketing Federation Ltd. (AMUL), from 2010-2023, which is the India's largest Food Products organization with annual group turnover of more than Rs. 71,000 crores (USD 9.00 billion) during the year 2022-23. Dr. Sodhi has 42 years of rich experience in leading & developing cooperative sector within Indian dairy industry, having served dairy farmers in several capacities. AMUL procures 28 million liters of milk per day from more than 18,600 Village Dairy Co-operative societies. The received milk is processed at 97 dairy plant across the India.

He is also the Chairperson of National Institute of Food Technology Entrepreneurship and Management (NIFTEM). Dr. Sodhi has also been appointed as Independent Director on the Board of one of the biggest Poultry organization of India IB Group (ABIS exports Pvt Ltd). Dr. Sodhi is also Independent Director on the Board of Escorts Kobuta Ltd., New Delhi. Dr. Sodhi is also providing his Advisory services to Reliance Retail Ltd. Dr. Sodhi was also the Board Member of International Dairy Federation (IDF).

For more than three decades, Dr. Sodhi worked under direct guidance & mentorship of father of white revolution, Dr. Verghese Kurien and has ensured that values cherished by Dr. Kurien, such as integrity, dedication, courage, honesty, commitment to farmers and to consumers, remained deeply ingrained in the culture of the organisation.

Dr. Sodhi obtained his Bachelor (Agri Engineering) degree from CTAE, Udaipur, India and he is first-batch alumnus from Institute of Rural Management, Anand (IRMA). Dr. Sodhi is the elected Fellow of National Academy of Dairy Science.

He received Doctor of Philosophy (Honoris Causa) from GADVASU and Doctor of Science (Honoris Causa) from Anand Agricultural University, Anand (Gujarat).

Dr. Girish Kolwankar
Director
Premium Chick Feeds Pvt. Ltd.

Dr. Girish Kolwankar, Visionary Leader and Stalwart Veterinarian in the Poultry Industry, for his relentless dedication, passion, and commitment to excellence.

After graduating from Mumbai Veterinary College in 1988, Dr. Girish returned to his native village of Alibaug, Maharashtra, where he began his career as a Livestock Development Officer under the state government. This role allowed him to immerse himself in the agricultural community, but it was only the beginning of a remarkable journey. Driven by his passion and expertise, he soon ventured into poultry consultancy, gaining an unparalleled, firsth and understanding of the livestock feed industry. Observing the unregulated nature of the market and the immense challenges faced by farmers striving for profitability, Dr. Girish recognized a significant opportunity to make a difference.

From these humble beginnings as a Livestock Development Officer to co-founding Premium Chick Feeds in 1991, Dr. Girish has been an unwavering advocate for quality and innovation. Entering this business with a profound attachment to animals as a veterinarian, he was guided by his steadfast belief that with passion, dedication, and an uncompromising commitment to excellence, success was not just a possibility but an inevitability. His visionary leadership has not only built a thriving enterprise but also created numerous job opportunities across India, empowering rural communities and driving transformative growth in the poultry sector. His foresight in forward integration, focus on superior nutrition, and unshakable conviction that veterinarians must lead the industry have set new standards of excellence.

In the face of daunting challenges-including the devastating bird flu outbreak and periods of economic turbulence-Dr. Girish's resilience has been nothing short of remarkable. Under his guidance, Premium Chick Feeds has flourished, evolving into a national powerhouse with a turnover of $650 million and operations spanning nine states. His exceptional ability to navigate adversity and seize opportunities has propelled his company to the forefront of the industry.

Dr. Girish's unwavering dedication to enhancing feed quality, uplifting the rural economy, and investing in state-of-the-art infrastructure has left an indelible mark on the poultry industry. His work has elevated not only the industry's standards but also the lives of countless individuals in rural areas, affirming his role as a true pioneer in the sector.

Dr. Manoj Mohanlal Sharma
Director
Mayank Aqua Products

Pioneer of Gujarat's Shrimp Farming Revolution
Ph.D. in Shrimp Farming | ICAR-CIFE Mumbai Alumnus (1991–1994)

World Aquaculture Society Global Industry Impact Award recipient

Experience:

30 years of hands-on leadership in sustainable shrimp farming, community upliftment, and industry development.

Key Contributions

- **First Demonstration of Freshwater Prawn Culture (1994)**

  Successfully introduced Macrobrachium rosenbergii culture in Gujarat, empowering villagers with profitable aquaculture practices and improving socio-economic conditions for fishing communities.

- **Introduction of Black Tiger Shrimp Farming (1996-97)**

  Demonstrated successful brackish water shrimp (Penaeus monodon) farming at Dandi village, Surat. This innovation converted barren, salt-affected coastal lands (Khar land) into productive aquaculture hubs which were earlier unfit for agricultural activity.

- **Transformation of Coastal Livelihoods**

  Enabled part-time, unemployed fishermen to become full-time aquaculture farmers, ensuring stable incomes and reducing dependency on declining capture fisheries. Made an individual coastal rural fishermen an Entrepreneur.

Leadership & Institution Building

- **Conceptualized Satellite Shrimp Farming**

  Unified shrimp farmers under collaborative, knowledge-sharing platforms to promote sustainable and profitable farming practices.

- **Founder of Key Associations**
  - **Surat Aquaculture Farmers Association (SAFA)**
  - **Gujarat Aquaculture Association (GAA) -** spearheaded state-level

aquaculture growth across Surat, Valsad, Navsari, and Bharuch, igniting Gujarat's **Blue Revolution.**

- **Today Gujarat shrimp farming industry values close to 300 million USD.**

- **Founder of Companies:**
  - Mayank Aquaculture Pvt Ltd (Director), Mayank Aqua Products (Partner), Zhingalala (Partner), Shrimp Producer and Producer Foundation, Manorama Aquatics (Partner).

Socio-Economic Impact

- Benefitted over **150,000** coastal and rural individuals through entrepreneurship and employment.
- Each hectare of shrimp farming generates employment for **8 to 10 individuals.**
- Catalysed rural infrastructure development — roads, electricity, and allied facilities - improving quality of life in remote areas.

Technical Excellence & Knowledge Sharing

- Developed and propagated **Best Management Practices (BMPs)** adopted by shrimp farmers across Gujarat.
- Active contributor to digital knowledge dissemination — regularly publishes articles and guidance to enhance farm productivity and resilience in shrimp farming communities across India.
- World renowned expert who has delivered talks and represented India across top world platform such Aquavision Skretting, Shrimp Summit by TCRS, AquaExpo Guayaquil, VIV Asia and many national and international representation.

Awards & Recognitions

- **State Award**
  - Best Fish Farmer (2005) — ICAR-CIFE, Mumbai
- **National Awards**
  1. Best Shrimp Farmer Award (2018) — National Fisheries Development Board, Govt. of India
  2. Agrivision Award (2020) — Akhil Bhartiya Vidyarthi Parishad
  3. Best Technology Infusion / Innovation Award (2021) — National Fisheries Development Board, Govt. of India
  4. ICAR-IARI Innovative Farmer Award (2023) — Indian Agricultural Research Institute, ICAR
- **International Award**
  - ARECA Plaque of Recognition (2018) — ARECA Firm Awards
  - Global Industry Impact Award (2024) — World Aquaculture Society

DR. O.P. CHAUDHARY
IFS (Retd.)

Dr. O.P. Chaudhary is a (Retd.) senior IFS officer in the Madhya Pradesh cadre with over 35 years of vast and varied experience in administration, regulation, scheme formulation, policy formulation, implementation, entrepreneurship development, training, and education.

He began his career at the district level and was subsequently promoted to various positions at the division and state levels in Madhya Pradesh. His areas of work in the state of Madhya Pradesh have mainly focused on forest management, wildlife management, biodiversity and eco-development, rural development, joint forest management, eco-tourism, indigenous peoples' participation in natural resource management, social forestry/agroforestry, plantation management, watershed management, forest produce management, and research development and extension, etc.

Dr. O.P. Chaudhary has an outstanding academic track record, having achieved academic excellence from top institutions in India and the world. He holds a B.Sc. (Gold Medalist) and M.Sc. (Physics) (Gold Medalist) from the prestigious Agra College (Agra University), an M.Tech (Environmental Engineering) from IIT Roorkee, an Executive MBA from IIM Lucknow, a PGDM (Human Rights Law) from the National Law School of India University (NLSIU), Bangalore, a Ph.D. (Finance Management) from Symbiosis International University, Pune, and has completed a Leadership Program from Harvard University, USA.

As Joint Secretary in the Ministry of Fisheries, Animal Husbandry & Dairying, Government of India, Dr. O. P. Chaudhary was responsible for overseeing the livestock sector (including feed and fodder) in India. He not only conceptualized but also implemented the National Livestock Mission and the Animal Husbandry Infrastructure Development Fund as the National Mission Leader across the country during his tenure of over 8.5 years. He made significant contributions to the livestock sector by promoting private sector participation and entrepreneurship development. His diverse academic background, coupled with field experience, established a solid foundation for a rich government-industry interface, which is crucial for the future growth of the livestock sector. He also brought a sharp focus to research, development, new technology, and innovation. Dr. O. P. Chaudhary was instrumental in many policy and procedural reforms to ease and open the sector.

He has held various positions in the Government of India, including Regional Provident Fund

Commissioner (Ministry of Labour), Member Secretary of the Rashtriya Kamdhenu Ayog, Chairman of the Animal Welfare Board of India (a statutory body), Chairman of the Committee for Control and Supervision of Experiments on Animals (CCSEA) (a statutory body), and Vice Chancellor of Rajasthan State University.

Dr. O. P. Chaudhary has traveled extensively within India and abroad, representing the country at various forums, and has been honored multiple times for his contributions in the areas of public administration, promotion of innovation, introduction of new technologies, entrepreneurship development, and educational advancement. He has also authored numerous technical papers and scientific publications.

Last posting was as the Principal Chief Conservator of Forests in the State of Madhya Pradesh.

Mr. R. Ramkutty
Managing Director
M/s.Niswin Enterprises

Core skills, Qualifications And experience:

A dyed-in-the-wool marketing professional, I have clocked 30 odd years working in various reputed companies. The pursuit to make a career in sales management field, armed with persuasive skills and congenital optimism and suitable academic credentials landed me in a sales job at Nicholas Pharmaceuticals (MNC) The career progression saw me taking on the field of Marketing as and launched me on my entrepreneurial journey.

Qualifications

B.Sc (Special)– Bachelor of Science – American College, Madurai in the year 1973

M.B.A., - Master of Business Management with Marketing from PSG College of Technology in the year 1976.

Immediately on completing my Post Graduation I had a short stint at PSG College of Arts & Science, Coimbatore as a faculty. Notwithstanding the fact that I followed my head to make a career in Marketing the heart was always in teaching. Later resumed as a regular visiting faculty for PSG Institute of Management, Coimbatore, As I do enjoy sharing the knowledge and experience with young minds it has become the part of my passion.

Current Status

Experience

- 2 Years Of Teaching in PSG Institutions
- 9 Years with Nicholas Pharmaceuticals(MNC)
- 5 Years with Leaders(Bangalore) in Food Products and animal Feed Industry 9 Years with Sakthi Sugars in Soya Division handling Marketing/ Exports.

Established as an Entrepreneur running Niswin Enterprises Group of Companies handling over 100 Crores Turnover.

NISWIN FOODS – Turnover is over 200 crores.
NISWIN GROUPS – Turnover is over 40 Million USD (300 Crores)

Public Life

Sales and marketing management indeed was quite a challenge. It did teach me many facets of selling, marketing, branding and business management in general. Above all it has metamorphosed me into a people's person and imbibed leadership skills. The ability to work with a wide range of people helps me playing varying roles in social life such as Industry platforms, Rotary, Sports, NGOs, Education and philanthropy.

Academic Pursuits

- Visiting Faculty in PSGIM.
- Academic Involvement over 10 years.
- Associated with Avinashilingam University.
- Member of Board of Studies in Management.
- Member of Board of Studies in Happy Valley School, Chavadi
- Member of Board of Studies in GRD College of Arts & Science
- Guest/Visiting Faculty for Many Business Schools.
- Academic Membership Involvement

Social Memberships

- Past President –Rotary Club of Spectrum,Cbe.
- PHF Member
- President in Coimbatore District Volleyball Association
- Member of Coimbatore Golf Club
- Member Of Coimbatore Cosmopolitan Club
- Member of Kerala Club
- Member of Jenneys Club

Professional Memberships

- Member in SOPA(Soya Bean Processing Associates)
- Spoke Person in BCC
- Member Chamber of Commerce
- Member in CII,CBE
- Member Coimbatore Management Association
- Industry & Commerce Membership
- Member in USSEC
- CLFMA – OB – Treasurer

Other Facts

Extensively traveled around the world for business and pleasure. Attended numerous seminars and conferences overseas

The Family

Wife Vathsala holding corporate Secretaryship degree is a partner in the business.
Son Nishanth finished M.S., in United States and currently heads Niswin foods

Dr. Ravindranath Shivashankar Masali
Associate Vice President
Nutrition, Godrej Agrovet Ltd.

Educational qualification : Completed under-graduation in 1993 from Bombay Veterinary College.

Completed post-graduation in 1995 from Nutrition Dept, Bombay Veterinary College.

Currently working in Godrej Agrovet Ltd, as Associate Vice President – Nutrition India & Bangladesh for past 22 years for all species. Prior to Godrej Agrovet, worked with Eagle Agro C&M Farming Ltd, KEMIN

Mr. Amit Sachdev
Techpro India

Mr.Amit Sachdev is a graduate in Agriculture and Animal Husbandry, from G B Pant University of Agriculture and Technology, now in Uttaranchal. Graduating from the class of 1987, he traveled to Europe for training in dairy & poultry farming and worked in farms in Denmark, Netherlands Belgium & Germany.

Coming back in 1990, he has been an independent consultant covering various aspects of livestock production, processing and marketing.

As an independent consultant, was responsible for making inroads in processed chicken marketing, value added chicken for Arambagh Hatcheries in East India, Baramati Agro in Maharashtra to name a few and machine milking in some private dairy operations.

Has also introduced US semen in India in 1996 and has been technical and strategy advisor to World Wide Sires, the world's largest AI marketing company, based out of California.

Since 1996, he represents U S Grains Council, in India, Bangladesh, Nepal and Sri Lanka.

For the council, he also covers poultry, dairy, poultry processing, biotechnology, ethanol and international trade and advises companies/individuals on the import scenario from US on Corn, Corn co-products (DDGS, Ethanol), Barley and Sorghum.

He has completed a course on HACCP in poultry and meat production from Mississippi State University and Texas A & M in USA.

In 2007 he was hired by US Meat Export Federation (USMEF) for the first assessment of the pork market in India and the second assessment was conducted in Dec 2017.

In 2007/08 he was part of the tour with US Trade Development Agency (USTDA) to provide information on Food safety issues in India to the retailers and producers as a guest speaker.

Also as an international agriculture trade analyst and India specialist, he is on the panel of various national agencies/companies.

Dr. Mahesh Subhash Patlapati
B.V.Sc., M.V.Sc., PGPPM (IIMB)

PROFILE:

- **Dr. Mahesh Patlapati**, Veterinarian from Bengaluru is a **Post Graduate in Virology,** Management Graduate from Indian Institute of Management, Bangalore **(IIMB)**, a premier Institute of Management in India. Worked in various capacities in Private Sector, Autonomous Institutions, State and Central Animal Husbandry Sectors of India.
- Presently serving as **Joint Commissioner & Director of Centre of Excellence for Animal Husbandry (CEAH)**, Government of India, a premier Academy for Animal Husbandry in India since 1st April 2023.
- Represented India in VIV Europe-2018 at **The Netherlands** and presented a talk on **"Prospects and Opportunities in Indian Poultry Sector"**
- Represented India in United States Department of Agriculture **(USDA)** Network Program during 2012 at Iowa, **USA** and delivered talks at USDA.
- Dr. Mahesh is an **invited Lead Speaker in various National Forums** viz., Poultry India Knowledge Day, The Compound Livestock Feed Manufacturers Association of India **(CLFMA of India)**, Indian Poultry Science Association Congress **(IPSACON-2017)**, Confederation of Indian Industries **(CII)**, and Federation of Indian Chambers of Commerce and Industry **(FICCI)**.
- Dr. Mahesh is an **Advisory Member to various Veterinary Universities** of Tamilnadu, Kerala and Karnataka. Expert Member of various Committees, Bureau of Indian Standards **(BIS)**, FAD-18, National Bank for Agriculture and Rural Development **(NABARD)**, Agricultural Skill Council of India (ASCI) and Institution of Veterinarians of Poultry Industry **(IVPI)**.
- Dr. Mahesh is awarded with **National Award of CLFMA** for the year 2018 at Goa.
- Dr. Mahesh is chosen as a **Group Leader** for Inter-ministerial Central Team **(IMCT)** for drought assessment in Karnataka during November, 2018.
- Dr. Mahesh addressed at **German – Indo Meat Mission** round table at Bengaluru during December, 2018.

- Dr. Mahesh is an Invited Speaker at 7th **PAN Common Wealth Veterinary Conference 2019**, India.
- Dr. Mahesh is an **invited Speaker at 107th Indian Science Congress** held at GKVK, Bengaluru on 3rd January, 2020 inaugurated by Hon'ble Prime Minister, Shri. Narendra Modi.
- **Chief Liaison Officer** representing Department of AH&D, Govt. of India for **Loksabha and Rajyasabha** committees during 2021.
- **Chief Guest for convocations** at GCC, HKBK, NSBA and IIBS, MBA colleges at Bengaluru during 2021 & 2022
- Prof. G. Devegowda, **Poultry Science Excellence Award 2022** on World Veterinary Day, 30th April, 2022 by Pashudhan Praharee

CONTACT :

Dr. Mahesh P.S. M.V.Sc., PGPPM (IIMB)
Joint Commissioner GoI & Director,
Centre of Excellence for Animal Husbandry,
Government of India,
Hessarghatta, Bangalore, Karnataka, India, Pin: 560 088.
Mobile: 0091-9845616268; Tel: +91-80-28466226/28466236
E-mail: ceah.bengaluru@gmail.com / drmaheshps@gmail.com
Website: www.cpdoti.org / Facebook: www.facebook.com/Ceah Bengaluru /
Youtube: CEAH Bengaluru Academy.

Dr. Manju N C
Animal Nutritionist

Completed post graduation in animal nutrition in 1999 from Bangalore. After heading 23.5 years of animal nutrition of Japfa Comfeed India Ltd for Indian and Bangladesh operations, started pursuing freelancing animal nutrition profile. Currently associated with key corporate integrators across India for animal nutrition and allied activities which involve optimizing breeder broiler and layer nutrition, setting up quality control laboratories and feed mill process optimization. Currently, handling 60 feed mills in various geographies including India, Myanmar and Bangladesh handling around 150000 MT per month. Passion involves setting up SOP of animal nutrition operations, quality control and feed plants.

Dr. GAGAN GARG
Deputy Commissioner (Trade)
Government of India

Position in Government of India:

Ministry of Fisheries, Animal Husbandry and Dairying, Department of Animal Husbandry and Dairying.

e-mail: gagan.garg@nic.in

Educational Qualifications:

- Masters in Veterinary Sciences
- Bachelor of Veterinary Sciences & Animal Husbandry
- Post Graduate Diploma in Agricultural Extension Management (PGDAEM)

Professional Experience:

- Regulation of trade in the country for livestock and livestock products including poultry
- Issuance of Sanitary Import Permits for livestock products including poultry & fishery products
- Co-ordination with International Bodies on policy, planning and maintenance of Livestock Health and Trade
- Alignment of Veterinary Health Certificates for mutual trade between the countries
- Bilateral co-operation related to livestock & livestock products
- Policy drafting, planning and implementation of livestock related schemes on all India level
- Clinical veterinarian for more than 11 years.

JAISON JOHN
Regional Head Market Intelligence - South Asia
U.S. Soybean Export Council (USSEC)

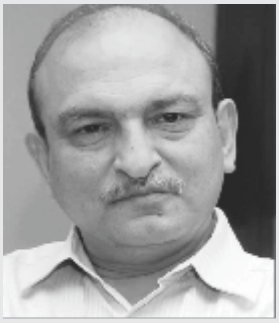
Jaison is a management graduate from DAVV, Indore, with a diploma in Agribusiness from XLRI, Jamshedpur. With an active presence in the agri-commodity domain for over three decades, Jaison is an expert in agri-commodity trading, especially for feed raw materials. He has a strong network in the domain and successfully mentored large teams and motivated them to achieve targeted goals. Currently, Jaison is working with USSEC (US Soybean Export Council) as **Regional Head of Market Intelligence - South Asia**. Earlier, he held the position of Country team lead for India with USSEC; before USSEC, he worked with Suguna Foods Pvt. Limited, India, as General Manager of Procurement. He was associated with organisations like Adani, Ruchi, and AL Saeed (Yemen) as a trader/commercial buyer.

Jaison is a member of

Solvent Extractors Association (SEA) DOMESTIC OIL MEAL COMMITTEE for the year 2018-19, 19-20, 21-22, 22-23,23-24, 24-25.

Member of CII National Committee on Animal Husbandry & Dairying for 22-23, 23-24, 24-25, 25-26. Member of FICCI's Task Force on Agribiotechnology for 2022-23, 23- 24.

and CLFMA's Management Committee member for 22-24, 24-26.



Shri. Tarun Shridhar
IAS (Retd.)
Director General, Indian Chamber of Food and Agriculture (ICFA)

Current position: Director General, Indian Chamber of Food and Agriculture (ICFA)

Positions held in the past: Member (Administrative), Central Administrative Tribunal May 2020 to May 2024

IAS (Himachal Pradesh:1984); retired from IAS on 31.07.2019

Experience related to Agriculture, Animal Husbandry, Fisheries, Rural Development and Public Affairs:

1. **Secretary, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India:** Closely involved in the creation of this ministry in 2019 and assisted in preparation of the detailed background paper in this regard. Prior to that, I had drafted the proposal for creation of a separate Department of Fisheries. Significant contributions were a) initiation of ETT and IVF for production of HGM Bulls; b) genomic selection programme; c) extension of AI programme; d) launching FMD and Brucellosis control programme, the biggest of animal disease programme of its kind; e) introduction of sex sorted semen production facility; f) launch of Dairy Infrastructure Development fund and FisheriesInfrastructure Development Fund; g) National Dairy Plan to strengthen dairy cooperatives infrastructure; h) Dairy Development Project under JICA assistance
2. **Additional Chief Secretary, Departments of Animal Husbandry and Fisheries, Government of Himachal Pradesh:** a) expanded the ambit and activities of milk cooperatives; b) prepared a scheme for door delivery of animal health and disease control services; c) launched a programme for genetic improvement of indigenous breeds, basically the Pahari Cow
3. Additional Chief Secretary, Department of Environment and Forest; Power; Horticulture.
4. Chairman, State Electricity Board.
5. **Joint Secretary, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India:** a) revived the shrimp industry through introduction of disease resistant and high productivity species leading to unprecedented growth making India the biggest shrimp exporter in the world; b) launched the national aquatic diseases surveillance and control programme; c) established the National Fisheries Development Board; d) established country's first and only aquatic quarantine facility; e) started the intensive reservoir stocking programme; f) represented the country in WTO negotiations on fisheries subsidies; g) introduced uniform vessel registration and fishermen's biometric identity card scheme; h) programme for enhancement of fresh

water aquaculture productivity

6. **Principal Secretary, Departments of Animal Husbandry and Fisheries, Government of Himachal Pradesh:** a) organised and strengthened milk cooperatives; b) expanded and revived the ailing state Milk Cooperative Federation; c) expanded AI coverage; d) organised a massive outreach programme for livestock farmers; e) introduced trout fish farming
7. **Principal Adviser National Cooperative Development Corporation (NCDC)** (post retirement): Advised and guided the organisation in organising cooperatives for remunerative livestock, dairying andfisheries activities. Prominent initiatives in the short period were a) launch of Meghalaya Milk Mission; b) Revival of milk cooperatives in Puducherry; c) Capacity building of Dairy professionals; d) ornamental fisheries etc.
8. **Deputy Director (Senior), Lal Bahadur Shastri National Academy of Administration, Government of India:** Specialised in training fresh recruits and in-service civil servants in Agriculture and Rural Development sectors
9. **Public Sector Undertakings:** Successfully and profitably managed the following organisations as a) Chairman, Himachal Pradesh State Electricity Board Limited; b) Managing Director, Himachal Pradesh Tourism Development Corporation and c) Managing Director, Himachal Road Transport Corporation
10. **Director, Ministry of Petroleum and Natural Gas, Government of India:** Looked after the marketing issues of Indian Oil, Bharat Petroleum, Hindustan Petroleum and erstwhile IBP oil companies

Conferred the Policy Leadership Award for the Dairy Sector in 2020 Awarded the degree of Doctor of Philosophy (Ph.D) (Honoraria Causa) in Veterinary and Animal Science by the Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, Punjab.

Conferred honorary Fellowship of the National Academy of Veterinary Sciences.

Conferred Animal Health Policy Leadership Award in 2022

Conferred Lifetime Achievement Award by CLFMA(Association of Indian Livestock Sector)

Conferred Lifetime Achievement Award by the Agriculture Today Group

Publications: Over 225 articles, **both in English and Hindi**, primarily on Agriculture, Rural affairs, Livestock, Fisheries and Dairy sectors in both mainstream and technical publications. The articles relate to diverse sub-sectors like dairy policy, economy, marketing milk products, value addition, livestock health, one health concept, fisheries and aquaculture economy, poultry etc. i) Indian Express, ii) Dainik Jagran, iii) Dainik Bhaskar, iv) The Tribune, v) Outlook, vi) Fair Observer (a USA based web magazine); and technical journals like i) Agriculture Today, ii) Indian Poultry Review, iii) Indian Dairyman, iv) Dairy India, v) Agriculture World, vi) Krishi Jagran

Writing on the sector on a regular basis.

Other Activities post retirement from IAS: 1. Authored Review of the Status of Aquaculture in Asia Pacific for Food and Agriculture Organisation (FAO); 2. Participated in FAO's global conference on Aquaculture as one of the three subject experts from the Asia Pacific region, and the only one from India; 3. Keynote speaker at the convocation of Puducherry Veterinary College; International Fish Expo; webinar on Atmanirbhar Indian Poultry organised by

Veterinary University, Mathura; in the two sessions, one on livestock health and the other on poultry in the Indo-Dutch summit; the annual convention of NADS; the annual conference of NAVS; Poultry Conclave etc. 4. Regular participation as subject expert in national and international conferences on Dairy, Poultry, Fishery and related subjects; 5. Consultancy and advice on a regular basis, purely in honorary capacity, to a large number of organisations and entities

Links to a few of the articles are: https://indianexpress.com/article/india/dairy-consumption-india-indian-express-6299595/, https://indianexpress.com/article/opinion/columns/indigenous-livestock-breeding-cows-cattle-6140142/, https://indianexpress.com/article/india/poultry-industry-egg-india-chicken-6061353/, https://indianexpress.com/article/opinion/now-also-an-aadhaar-card-for-cattle-and-buffaloes/, https://indianexpress.com/article/india/milk-processing-like-its-name-khoya-a-lost-opportunity-for-dairies-6185018/, https://indianexpress.com/article/india/agriculture-and-nutrition-the-way-forward-in-milk-fortification-6084757/, https://indianexpress.com/article/opinion/columns/indias-milk-production-domestic-markets-milky-way-5987156/, https://indianexpress.com/article/india/harnessing-the-fruit-of-the-sea-5925011/, https://indianexpress.com/article/india/livestock-sector-a-new-ministry-promises-a-new-beginning-5849379/, https://indianexpress.com/article/explained/an-expert-explains-why-healthy-animals-mean-healthy-humans-and-how-to-meet-that-goal-5783537/https://indianexpress.com/article/explained/explained-why-it-is-important-to-count-indias-chickens-and-cows-5653627/, https://indianexpress.com/article/opinion/columns/animal-husbanry-fishries-blue-revolution-that-will-be-5607509/, https://www.fairobserver.com/region/central_south_asia/tarun-shridhar-indian-government-ministry-agriculture-india-news-farmers-world-news-68791/, https://www.fairobserver.com/region/central_south_asia/tarun-shridhar-indian-shrimp-market-coronavirus-india-lockdown-economic-impact-27919/, https://www.fairobserver.com/region/central_south_asia/tarun-shridhar-buffalo-milk-animals-india-news-south-asian-world-news-17837/, https://magazine.outlookindia.com/story/outlook-spotlight-how-dreams-turn-reality/302404, https://www.tribuneindia.com/news/archive/features/himachal-s-disastrous-slide-man-made-not-natural-822387, http://indianpoultryreview.com/2020/09/20/fowl-play-poultry-through-ages/, http://indianpoultryreview.com/2020/12/28/antimicrobial-resistance-sifting-fact-from-fiction/, http://indianpoultryreview.com/2020/10/20/national-action-plan-for-egg-strong-on-intent-short-on-strategy/, http://indianpoultryreview.com/2020/11/24/towards-an-atma-nirbhar-animal-husbandry-development/, https://www.agriculturetoday.in/important-articles/TarunShridhar-2022.pdf https://www.agriculturetoday.in/important-articles/TarunShridhar.pdf https://www.agriculturetoday.in/important-articles/Tarun_Shridhar_Rich_Farmer_Equals_Rich_Nation.pdf https://www.agriculturetoday.in/important-articles/Feb_2021_Tarun_Shridhar.pdf https://www.agriculturetoday.in/important-articles/ac-2.pdf

Mr. Suresh Chitturi
Vice Chairman & Managing Director
Srinivasa Farms

Suresh Chitturi, leads Srinivasa Farms, a dominant force in the Indian Poultry Industry. Srinivasa is recognised as one of the builders of the Indian Poultry Industry in the last 50 years. After assuming leadership, Suresh steered Srinivasa to achieve sustainably high growth through expansion and diversification. Srinivasa is involved in Chicken Breeding, Chicken & Egg Processing, Feed Manufacturing and also Soya Oil Extraction and Processing.

His work has led to the company being recognised for always doing what is best for the individual farmers, industry and the country. Adopting a farmer first philosophy, he is passionate about ensuring that the poultry industry is healthy and sustainable through adoption of latest technologies, good rearing practices and welfare of the livestock. Suresh is helping the industry to be more sustainable and responsible in its production and sourcing.

Suresh is driven by the mission of eliminating nutritional deficiencies of women and children in India. He passionately advocates poultry as a vehicle of transformation and empowerment. His work has been recognised at a global level and is engaged in advocacy for the poultry industry, internationally as Chairman of World Egg Organisation (WEO). He is the first Asian to hold this position in the history of the institution.

Besides work, Suresh is active in wildlife conservation through his work with WWF and other conservation minded organizations. He is also a talented photographer and has exhibited his photographs for raising awareness and funding for conservation.

Suresh takes pride in the role he played in the two telugu states (Telangana and Andhra Pradesh) become leaders in ease of doing business, through his work in CII in various capacities. An avid reader, averaging 50 books a year, he also loves to travel and learn about different cultures and their history.

Education

Bachelor in Computer Science Engineering,R.V College of Engineering, Bangalore.

Master of Business Administration, Goizueta Business School, Emory University, USA.

The President's Programme in Leadership, Harvard Business School, USA.

Doctoral Candidate in DBA, Golden Gate University.

Professional Affiliations & Board Memberships

Chairman CII Animal Agriculture Taskforce.

Co-Chairman Taskforce on Family Business of CII Southern Region.

President (2022-2024), Chairman (2019-2022) & Vice Chairman (2017-2019), World Egg Organisation (WEO), U.K. Councillor for International Egg Foundation.

Co-founder of TiE Vizag Chapter.

Vice - President of All India Poultry Breeders Association.

Mr. Divya Kumar Gulati
Managing Director
Nurture Technology
& Chairman, CLFMA of India

Mr. Gulati brings over 30 years of extensive experience in the healthcare, nutrition and food industry. Throughout his illustrious career, he has played a pivotal role in introducing and establishing innovative and sustainable solutions that have been instrumental in changing industry standards. As the Managing Director of Nurture Technology, Mr. Gulati has not only been a pioneer in bringing the probiotic culture for shrimp farming to India in the 1990s and introducing modern farming technologies but also developed a host of innovative products through an amalgamation of ayurvedic herbal ingredients, modern technologies and extensive clinical trials that have provided the poultry and dairy industry a fresh outlook and tremendous results.

Over the past half decade Mr. Gulati has also successfully forayed into Human Healthcare and Food Industry, having set up research and production facilities that offer consumers high quality healthcare and food ingredients. As the Co-Founder of Herbs & Health and Grind Essentials, Mr. Gulati has brought his vast experience in the animal healthcare industry to the human health care space.

Mr. Gulati has also been an instrumental part of CLFMA of India for the past 12 years. Currently, he is the Chairman of CLFMA of India and he has been instrumental in making in-roads into the Government Fisheries, Animal Husbandry and Dairying Ministry and Department which helped in creating a greater understanding and communication between the animal healthcare industry and the government ministry via the association. Through years of communication and relationship building with the Ministry, Mr. Gulati announced the launch of the CLFMA Students Program at this year's symposium. This unique initiative invites students across the country to present research projects addressing real-world challenges in poultry, dairy, swine, and aquaculture sectors creating pathways for youth involvement and innovation in animal agriculture. He remains steadfast in championing the interests of livestock farmers and sector players by promoting sustainable practices, facilitating knowledge exchange, and supporting policies that strengthen India's livestock economy. Our efforts focus on enhancing productivity, animal health and welfare, food safety, and the adoption of advanced technologies to meet evolving consumer and market demands, through various seminars and farmers' orientation programs. His deep understanding of industry needs and government policies, relationship building skills, and his forward-thinking approach have earned him the respect and admiration of colleagues, peers, and competitors alike.

Mr. Ranpal Dhanda
President
Poultry Federation of India

Mr. Ranpal Dhanda has been associated with the poultry sector for over three decades. He began his career as a small poultry farmer and today is counted among the leading poultry entrepreneurs in the country. Presently, he operates several feed mills, breeding farms, poultry farms, and a state-of-the-art slaughter house. In addition to poultry, he is also successfully engaged in various other businesses across India.

Mr. Dhanda has been actively involved with the Poultry Federation of India for many years and has been serving as its President since 2021. Under his leadership, the Federation has undertaken several significant initiatives for the welfare of the poultry sector and has played a pivotal role in giving the industry a new direction.

Notably, Mr. Dhanda has been consistently working towards the empowerment of small and medium poultry farmers. His vision, dedication, and leadership have strengthened the poultry industry and laid the foundation for a brighter future.

Mr. Daljeet Singh Gill
President,
Progressive Dairy Farmers Association

Mr. Daljeet Singh Gill is a renowned dairy farmer and a prominent figure in the field of dairy entrepreneurship in Punjab and across India. With over two decades of experience, he has played a transformative role in modernizing and professionalizing dairy farming practices.

He assumed leadership as the President of the Progressive Dairy Farmers Association (PDFA), Punjab, in 2002. Under his guidance, PDFA has grown into a robust organization with a membership exceeding 10000 progressive dairy farmers, each maintaining an average herd size of over 50 animals.

Mr. Gill has been instrumental in introducing and promoting innovative, sustainable, and profitable dairy farming practices. His efforts have led to a remarkable improvement in productivity and efficiency in the dairy sector in Punjab. With exposure to leading dairy industries across the globe, he has replicated best global practices and adapted them to the local context in India.

Through PDFA, he organizes monthly seminars for member farmers, featuring expert speakers in breeding, feeding, and farm management. Furthermore, he oversees the annual International Dairy and Agriculture Expo, one of India's largest exhibitions of its kind, attracting over 100,000 dairy farmers from India and neighboring countries. The expo features livestock competitions judged by international experts and showcases the latest in dairy technology and innovation.

Currently, Mr. Gill serves as the President of the All India Progressive Dairy Farmers Association (AIPDFA), where he is actively working to extend the success model of Punjab's organized dairy farms across the country.

Key Achievements:

- President, PDFA since 2002
- President, AIPDFA (All India Progressive Dairy Farmers Association)
- Managing a herd of 500 + cows
- Conducted global study tours and implemented international best practices in India
- Organizer of India's leading dairy expo, with 100,000+ annual footfall

Progressive Dairy Farmers' Association (Regd.) PDFA is a pioneer organization working for the overall development of dairy farmers. It was established in 1972 under the technical support of Punjab Agricultural University, Ludhiana and after bifurcation in 2006, still PDFA (Progressive Dairy Farmers Association) motive to work for the welfare of farmers is still on. A leaflet under the name of Dairy Sandesh was started in 1990 to disseminate the information to the dairy farmers which was converted into full fledge quarterly technical magazine "Dairy Sandesh" in 2006 which is distributed among the member farmers free of cost. Monthly seminars are organizes by the association to keep the farmers in touch with new technologies. PDFA publishes technical books on dairy farming and animal nutrition to provide readymade information. It organizes International Dairy Show and Exhibition every year to motivate the farmers to keep good quality animals and to bring the scientists, companies and farmers at a single platform. Association imports semen of high genetic potential cattle bulls from USA. During 2008, about 9000 frozen semen doses were procured from CRI and during current year 12000 FSD imported by the association from World Wide Sires Ltd. USA. Association provides loans to the dairy farmers on low interest rate by tie up with UCO Bank. To provide better milk procurement price to the farmers' association tie up with MILKFED Punjab. To provide better technical and medical support to the member farmers, mobile help van facility is being provided. More than 10000 dairy farmers are associated with PDFA".

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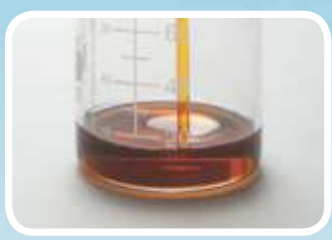
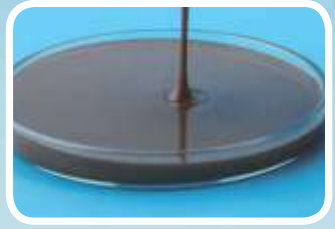

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Saji Chacko
President
Society for Aquaculture Professionals (SAP)

Saji Chacko is the President of the Society of **Aquaculture Professionals (SAP)**, an India-based network of aquaculture scientists, technocrats, and industry leaders with a mission to advance sustainable aquaculture. With over 30 years of experience in shrimp farming, Saji has played a pioneering role in introducing and scaling **Litopenaeus vannamei** in Gujarat, catalysing a shift in India's aquaculture productivity landscape.

He has previously managed commercial shrimp operations in East Africa, including high-value live fish handling systems, and worked with species such as P. monodon, grouper, tilapia, and seabass. Saji has received several national accolades, including the **MPEDA Best Farmer Award** and **Innovative Farmer Award** for his contributions to farming innovation and sustainability.

An alumnus of the Central Marine Fisheries Research Institute (CMFRI), he holds a Master's in Mariculture and a Bachelor's in Zoology. Under his leadership, SAP has worked closely with regulatory bodies such as MPEDA, NFDB, RGCA, CAA, and CIFE, and is affiliated with global organizations like WAS and GSA.

Saji brings a systems-thinking approach to the intersection of aquaculture, food security, and climate resilience. His focus lies in building policy, research, and grassroots synergies for a **Viksit Bharat** that includes the Blue Revolution.

Speaker Points - Outlook of Animal Agriculture for Viksit Bharat

1. **Aquaculture in Animal Agriculture Vision**
   - Integrate aquaculture into national protein strategy and policy frameworks.
2. **Climate-Smart, Water-Efficient Protein**
   - Leverage shrimp, fish, cage and coastal farming as efficient protein sources.
3. **Integrated Farming Systems**
   - Promote circular models linking agriculture, aquaculture, and livestock.
4. **Domestic Demand Creation**
   - Push fish into public nutrition and build strong local seafood markets.
5. **Engaging Youth through Tech**
   - Drive aquaculture innovation with AI, IoT, and smart farming startups.
6. **Education & Skills Reboot**
   - Revamp curricula with practical exposure, entrepreneurship, and PPPs.
7. **One Health & Biosecurity**
   - Control AMR risks through unified health frameworks and better oversight.
8. **Livelihoods & Inclusion**
   - Empower women, youth, and rural communities through aquaculture.
9. **Viksit Bharat 2047**
   - Build sustainable, traceable, inclusive protein ecosystems for the future.
10. **Policy & Regulatory Reform**
    - Clarify CRZ, align coastal policies, and enable sectoral convergence.

Ravi Kumar Yellanki
President
All India Shrimp Hatchery Association

Ravi Kumar Yellanki is a leading figure in India's shrimp aquaculture industry, with over two decades of dedicated experience. He is the Managing Director of Vaisakhi Bio-Marine Pvt. Ltd. and Vaisakhi Bio-Resources Pvt. Ltd., two of India's foremost shrimp hatchery operators, which also manage one of the largest shrimp farming operations in the country.

Starting his career as an engineer in aquaculture, Mr. Yellanki has played a pivotal role in shaping the sector by establishing a robust network of hatcheries across India. His contributions extend beyond business leadership — he has authored numerous papers and articles on shrimp hatchery management, focusing on its critical role in adapting to changing environmental and disease challenges.

Deeply committed to the industry's sustainable growth, he continues to advocate for responsible and innovative approaches to shrimp farming in India.

In addition to his corporate leadership, Mr. Yellanki is active in industry bodies. He currently serves as the President of the All India Shrimp Hatchery Association (AISHA) and is the Past President of the Society of Aquaculture Professionals (SAP) — a reflection of his ongoing dedication to advancing the aquaculture ecosystem at a national level

Madan Mohan Maity
General Secretary
West Bengal Poultry Federation Association

- **General Secretary,** West Bengal Poultry Federation – Constituted by the Government of West Bengal in 2009, the Federation monitors and facilitates the development and reorganization of poultry production in the state since inceptions, 2009.
- **Zonal Chairman,** National Egg Coordination Committee (NECC), India – Kolkata/West Bengal Zone, from 1994.
- **Managing Director,** Maity Animal & Avian Nutrition Pvt. Ltd. – A leading poultry and cattle feed production company in West Bengal.
- **Chairman & Managing Director**, Maity Poultries Group of Companies – The group is engaged in Direct poultry farming, breeding, and a wide range of poultry-related activities. It has introduced modern international techniques and hygienic layer poultry farming practices in West Bengal and is the largest producer of table eggs (including value-added eggs) in Eastern India. since 1990.

Additional Roles & Contributions

- **Executive Council Member**, West Bengal University of Animal and Fishery Sciences, Kolkata.
- **Chairman**, Midnapore Rotary Eye Hospital – Providing affordable and quality eye care services to underserved communities and engaged in best eye care services to affordable people in south Bengal,
- **Rotarian** since 1994 – Held several key positions including Assistant Governor, Rotary District 3291.
- **Former Member**, State Agriculture Commission, Government of West Bengal.
- **Secretary,** Kumarpur Arabindo Jana Kalyan Sanstha – An organization focused on the formation and development of Self-Help Groups (SHGs) for underprivileged communities. Established in the early 1990s and actively functioning in Paschim Medinipur district.

Mr. Uday Singh Bayas
President – IPEMA / Poultry India
Managing Director – VijayRaj Poultry Equipment Pvt. Ltd.

Mr. Uday Singh Bayas is a visionary leader and a driving force in the global poultry industry. Currently, he serves in dual leadership roles - **President of the Indian Poultry Equipment Manufacturers' Association (IPEMA) / Poultry India, and Managing Director of VijayRaj Poultry Equipment Pvt. Ltd.**, a legacy company founded by his father in 1972. With over three decades of experience, Mr. Bayas brings a powerful combination of strategic foresight, deep industry expertise, and an unwavering commitment to innovation and growth.

Academically, Mr. Bayas did his graduation from Osmania University and completed his **management studies at Shiv Shivani Institute of Management, affiliated with Jawaharlal Nehru Technological University.** This educational background has supported his growth as a balanced and forward-looking leader.

Mr. Bayas began his professional journey in 1994, joining VijayRaj Poultry Equipment Pvt. Ltd. during a time when backyard poultry farming was still prevalent in India. Taking charge of marketing and operations, he transformed the company from a domestic manufacturer into an internationally recognized brand. Under his leadership, VijayRaj has executed turnkey poultry projects and supplied advanced equipment across Africa (Kenya, Nigeria, Zambia), the Middle East (Kuwait), and South America, while forging strategic alliances, including a partnership with NAS Holdings in Nairobi.

His involvement with IPEMA spans over 15 years, beginning as Joint Secretary in 2008, later serving as Treasurer in 2011, and taking on the role of President in 2023. His **leadership of the 16th Poultry India Expo 2025** made it the largest poultry exhibition in South Asia, attracting over 40,000 international visitors and 400+ exhibitors from more than 50 countries. These efforts have positioned Poultry India as a premier platform for innovation, collaboration, and knowledge-sharing in the poultry sector.

A strong advocate for inclusive development, Mr. Bayas has worked relentlessly to extend modern poultry solutions beyond large commercial farms to underserved and rural communities. His initiatives in regions like North-East India and Maharashtra have helped promote backyard poultry farming, creating sustainable livelihood opportunities and strengthening the grassroots of India's poultry ecosystem.

Known for his **quiet yet effective leadership**, Mr. Bayas leads by example—valuing decisive action, continuous learning, and team development. His focus on nurturing talent, embracing

innovation, and leveraging technology is **helping IPEMA/Poultry India grow from strength to strength**, with results expected to be even more evident in the upcoming **17th Poultry India Expo.**

During his younger years, Mr. Bayas was a **100-meter sprinter representing Telangana state**. He credits his early involvement in athletics for instilling the discipline, perseverance, and competitive spirit that continue to guide his leadership and drive for success.

Roles and Responsibilities as President – IPEMA / Poultry India

As the **President of the Indian Poultry Equipment Manufacturers' Association (IPEMA) / Poultry India**, Mr. Uday Singh Bayas plays a pivotal role in advancing the poultry industry in India and strengthening its global presence. His key responsibilities include:

- **Strategic Leadership:** Providing vision and direction to IPEMA/Poultry India, aligning the association's objectives with industry trends and national development goals.
- **Industry Advocacy:** Representing the interests of Indian poultry equipment manufacturers and stakeholders to government bodies, trade associations, and international forums to ensure favourable policies, infrastructure support, and growth opportunities.
- **Expo Leadership:** Overseeing the planning and execution of the annual Poultry India Expo, Asia's premier poultry industry exhibition, ensuring it remains a hub for innovation, collaboration, and knowledge-sharing.
- **Stakeholder Engagement:** Fostering relationships with domestic and international partners, trade delegates, and industry leaders to promote investment, innovation, and collaboration across the poultry value chain.
- **Capacity Building:** Promoting skill development, technology adoption, and knowledge dissemination across member organizations and the broader poultry ecosystem, especially among small-scale and emerging players.
- **Sustainability & Inclusivity:** Advocating for sustainable practices in poultry farming and ensuring inclusive growth by encouraging initiatives that support rural poultry farmers, backyard poultry, and underserved regions.
- **Policy Input & Regulation:** Participating in policy dialogues, offering expert insights, and contributing to the formulation of industry regulations, standards, and quality benchmarks.

Through these responsibilities, Mr. Bayas continues to contribute meaningfully to the progress of IPEMA/Poultry India and to the steady advancement of India's poultry sector on the global stage.

Prof. Dr. Pankaj Kumar Shukla
Professor and Head
Department of Poultry Science
College of Veterinary Science and Animal Husbandry
U. P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan, DUVASU, Mathura- 281001 (U.P.), India
Former Joint Commissioner (Poultry), Govt. of India
e-mail: pankajkumar.shukla@upvetuniv.edu.in, pksmathura@yahoo.co.in
Phone: 0565-2471654 (Res.),
09458478252, 09457210857, 09897303876 (Mob).

Prof. P. K. Shukla, Professor and Head, Department of Poultry Science, U. P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan, DUVASU, Mathura (U.P.), India is graduate of Veterinary College Jabalpur. He obtained M.V.Sc. in Poultry Science from Indian Veterinary Research Institute, Izatnagar. and Ph.D. in Poultry Science from Chandra Shakhar Azad University of Agriculture and Technology, Kanpur. He has been decorated with numerous prestigious awards and honors including "Best Outgoing Graduate Award", "Rastrapati Award" in Scouting, "Life Time Achievement Award" by CLFMA, "Life Time Achievement Award" by Govt. of India, "Life Time Achievement Award" by Agriculture Today, "Distinguished Faculty Award" by Venus International Foundation, Chennai, "Deputy Director General, NCC, Uttar Pradesh Appreciation Award", Lifetime Achievement Award by Pashudhan Prahari, Certificate of Excellence Award by Indian Poultry Review, Poultry Legend Award in Padamshree Dr. B.V.Rao Poultry Entrepreneurs Global Icon Award 2020,etc.

Prof. Shukla is distinguished **fellow** of National Academy of Veterinary Sciences and National Academy of Veterinary Nutrition and Animal Welfare. He had been the **Member Secretary** of the prestigious "Central Poultry Development Advisory Council of Government of India, **Member**"Joint Working Group" under MOU signed between India and Uganda on the co-operation in the field of agriculture and Allied sector, **Member**, Joint Monitoring Group" Of Govt. of India for Avian Influenza of Ministry of Agriculture & Ministry of Health and Family Welfare, **Chairman**, Committee on Bilateral issues during New Delhi International Ministerial Conference on Avian and Pandemic Influenza, **Member**, Rural Advisory Committee of Doordarshan, Mandi House New Delhi, **Member**, Breed Registration "Committee for Registration of Poultry Breed" in Indian Council of Agricultural Research, **Member** of Research Advisory Committee of Central Avian Research Institute, Izatnagar and Project Directorate on Poultry, Rajendra Nagar, Hyderabad, **Member**, QRT for Indian Veterinary

Research Institute, Izatnagar, Member, National Advisory Committee for Animal Husbandry and Dairying Sector of Ministry of Fisheries, Animal Husbandry and Dairying, Government of India Chaired by Union Minister of Fisheries, Animal Husbandry and Dairying, Government Of India, **Chairman**, Scientific Panel on Meat and Meat Products including Poultry of FSSAI, **Advisor**, Agriculture Skill Council of India for Poultry Development, **Member** Board of Management, RAJUVAS, Bikaner, **Member**, Academic Council, NDVSU, Jabalpur, **Member**, Academic Council, ICAR-IVRI, Izatnagar, **Member**, Academic Council, BASU, Patna etc.

Earlier Professor Shukla worked as **Dean**, College of Veterinary Science and Animal Husbandry, U. P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go Anusandhan Sansthan, DUVASU, Mathura, **Scientific and Technical Advisor to Vice Chancellor**, DUVASU, Mathura. He worked as **Joint Commissioner (Poultry)**, Government of India in Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi from May 2007 to April 2012, playing a crucial role in the Policy, Planning & Program implementation especially in Poultry Sector. He also served as **Dean Post Graduate Studies, and Registrar**, DUVASU, Mathura. He believes in dissemination of relevant information amongst various stake-holders and has about 316 publications in his credit besides 4 books13 book chapters and two laboratory manuals. He has guided more than 30 M.V. Sc. And Ph.D. students. He authored several Policy Papers and Status Papers and is on the editorial boards of several journals and magazines of repute. Presently Prof. P.K. Shukla is engaged in research and education management in veterinary science and providing leadership for overall Poultry development in country.

Dr. M. R. Reddy
General Secretary, Association of Avian Health

Dr. M. R. Reddy is Principal Scientist at Avian Health Laboratory, ICAR-Directorate of Poultry Research, Hyderabad. He has a veterinary degree (BVSc&AH) from AP Agricultural University, Tirupati, AP, Master's degree in Avian Diseases from IVRI, Izatnagar and Doctoral degree (Avian Health) from the University of Melbourne, Australia. He is a Diplomate of Australian College of Veterinary Scientists (MACVS) in Poultry Health and Indian College of Veterinary Pathology, (Diplomate ICVP). He has 32 years' experience in Poultry disease diagnosis, research and poultry health management. His research interests include surveillance of avian mycoplasma infections, Infectious bronchitis, Newcastle Disease, Infectious laryngotracheitis, Chicken anaemia, Marek's Disease, eradication of ALVs from pure-line chickens and molecular characterization of poultry pathogens. He has been engaged in contract research, consultancy and contract diagnostic services to the poultry industry. He conducted training programs on “poultry health management and disease control” to industry personnel. He and his co-authors have published 75 scientific papers, 35 technical articles and he is the author of two books. He was awarded Melbourne International Research Scholarship and best poultry scientist award. He is an external faculty of ICAR-IVRI, guided 7 MVSc and 5 PhD students. He presented several lead and guest lectures in scientific and technical meetings. He is the founder General Secretary of Association of Avian Health Professionals (AAHP) and served as Chief Editor of Indian Journal of Veterinary Pathology. He is acting as member of expert committees at state and national level.

Dr Ajay Deshpande
President VIP & MD
Siddhivinayak Poultry breeding farm & hatcheries Pvt. Ltd.

Graduated in 1992 from Marathwada Agricultural University

Worked with Pure-line Poultry Breeding Company in Nashik, Maharashtra from 1992 to 2000

Was a freelance consultant from 2000 to 2007

Founded Siddhivinayak Poultry Breeding Farm & Hatcheries Pvt Ltd in 2009.

Have breeders and broiler integration operations in Maharashtra with head office at Pune.

Dr. Mukesh Sharma
B.V.Sc. & A.H., M.V.Sc. (Animal Nutrition), DCA, DIM
Senior Dairy Nutrition Consultant | Farm Advisor | Herd Performance Strategist

Professional Profile

Dr. Mukesh Sharma is a distinguished **Animal Nutritionist and Dairy Management Expert** with over **25 years of industry-leading experience** in **dairy nutrition, large herd management, milk procurement, and feed formulation**. As a trusted advisor to some of India's most progressive dairy farms and feed mills, he specializes in **total mixed ration (TMR) balancing, Different feed supplements formulation,** and **rumen modulation strategies** to enhance **milk yield, fat %, fertility, and overall cow health**.

Currently serving as a **Consultant to over 10 commercial farms and 6+ regional feed manufacturers,** Dr. Sharma provides **on-site and remote ration planning, farm SOP development, and training to veterinary and feed mill teams** across India.

Core Expertise

- Precision Nutrition Planning for High-Yielding Dairy Cattle
- Bypass Fat Evaluation & Rumen Buffer Integration
- Total Mixed Ration (TMR) Formulation & Silage Management
- Feed Mill Technical Support & Mineral Premix Design
- Heat Stress Management & Transition Cow Nutrition
- Fertility Enhancement through Nutritional Interventions and As Ultrasound expert
- Rumen Health Strategies & SARA Prevention
- Dairy Herd Performance Analysis & Corrective Feeding
- Training of Farmers, Vets, AI Workers & Field Staff

Current Engagements

- **Farm Advisor** to:
  Sarda Dairy (Raipur), Moo Farms (Tamil Nadu), Kanha Dairy (Bilaspur), Shree Ganesh Farm (Korba), Aahna Dairy (Jaipur), Gaudhuli Farms (Siliguri)
- **Nutrition Consultant** to Feed Mills in:
  Punjab, Chhattisgarh, Gujarat, Maharashtra, Uttar Pradesh
- **Gyanec and Management Consultant for PDFA Farm Members.**

- **Advisor & Committee Member:**
- Chhattisgarh & Madhya Pradesh Government Dairy Initiatives
- PDFA Punjab
- CG Kamdhenu University

Professional Experience

General Manager (Dairy Operations & New Project Development) – Abis Dairy (IB Group) Chhattisgarh

Oct 2013 – Sep 2018

- Spearheaded **India's largest dairy farm with 5000+ animals**, including **2200 buffaloes.**
- Successfully procured **60,000 liters of milk per day** through a farmer-based direct transfer system.
- Led **milk processing and retail operations**, ensuring **quality and efficiency.**
- Implemented **automated milking and breeding technology**, improving productivity.

Assistant General Manager (Dairy Herd Management) – Abis Dairy (IB Group)

Chhattisgarh

Apr 2010 – Oct 2013

- Optimized herd nutrition and milk yield through **scientific feeding strategies.**
- Improved breeding **efficiency and herd health**, reducing disease incidence.
- Streamlined dairy **operations, manpower, and resource management.**

Senior Technical Manager (Dairy) – Abis Dairy (IB Group) Chhattisgarh

Oct 2005 – Mar 2008

- Led dairy **process improvement initiatives**, increasing **milk yield and profitability.**
- Established **quality control measures** to meet **industry standards.**

Officer In-Charge (Dairy Operations) – – Abis Dairy (IB Group) Chhattisgarh

Aug 2001 – Oct 2005

- Managed **end-to-end dairy Farm Operation operations**, including **feed formulations,** feed milling operation, TMR balancing and animal health.

Junior Research Fellow (Veterinary Medicine, India)

Jan 2001 – Aug 2001

- Conducted **dairy research** on **animal health and nutrition.**

Major Contributions

- Designed Many formulations for mastitis and repeat breeding prevention
- Led India's first automated buffalo milking system for 2200 animals
- Successfully managed nutrition for 5000+ crossbred and buffalo herds
- Achieved exceptional results in AI conception rates through nutritional correction
- Delivered farm profitability by aligning nutrition with lactation stage, heat load, and fertility

Recognitions & Research

- **Field Veterinarian Award – 2005** (ISVM)
- **Nominated for Leading Scientist Award – 2010** (IBC, England)
- Published **40+ scientific papers in national and International Journals** and deliveredtraining to hundreds of field veterinarians, farmers, and AI workers across India

Global Exposure

- Visited dairy institutions and farms in **USA, Italy, Netherlands, France, Germany, Thailand, and Vietnam, Saudi Arabia.**
- Trained at **Babcock Institute, Wisconsin**, CRI USA, NDRI Karnal, CIRB Hisar, SAG Bidaj

Present Address – 46, Chauhan Park View, Besides Shankara Collage, Junwani Bhilai, Durg Chhattisgarh - 490020

Dr. Shirish Nigam
Managing Director
South Asia, EW Nutrition

President, INFAH (Indian Federation of Animal Health Companies) General Secretary, WVPA -India (World Veterinary Poultry Association) National Co-Convenor, Entrepreneur's Wing of IVA (Indian Veterinary Association)

Profile

Dr. Shirish is an accomplished leader having more than 30 years of rich experience in sales, marketing, and general management across multiple global animal health organizations. His area of specializations includes change management, strategic planning & business development. A veterinary graduate from MHOW, M.P, post-graduate in management from IIM, Kolkata and Advance Management Program from IESE, Barcelona, Spain. Dr. Shirish has worked in organizations like Pfizer, Alembic, Jubilant Life Sciences & is currently **Managing Director – South Asia at EW Nutrition**, an Indian subsidiary of EW Nutrition Gmbh, Germany which he has launched here in South Asia since 2012. https://ew-nutrition.com/

Dr. Shirish is also very active in various Industry groups and events.

He is currently President of INFAH (Indian Federation of Animal Health Companies). Guided by a vision of fostering trust among veterinary professionals and stakeholders across livestock, poultry, aqua, and companion animal domains, INFAH strives to elevate the animal health industry's standing and societal contributions. INFAH today has emerged as a prominent force in the animal health sector, boasting a strong membership of 57 companies representing diverse segments of the animal health industry. https://www.infah.org/

Dr. Shirish is also General Secretary of WVPA -India (World Veterinary Poultry Association). The World Veterinary Poultry Association-India is a national professional body for poultry veterinarians and poultry professionals for the benefit of Indian Poultry industry. The objective of the Association is to bring the academician, researchers, industry professionals to a common platform for discussion and exchange of ideas amongst those engaged in veterinary aspects of poultry health, welfare, disease, husbandry, and food safety. http://wvpa.in/

Dr. Shirish holds the position of National Co-Convenor of Entrepreneur's Wing of IVA (Indian Veterinary Association). All India Veterinary Association came into existence in the year 1922 and today has more than 60,000 veterinarians from across the country. Entrepreneur's Wing at aims to facilitate proactive policy making to support animal husbandry sector related business activity across value chain by connecting the dots between companies, enterprises, and policy makers.

https://www.indianveterinaryassociation.in/

Mr. Abhay Arvind Shah
Jt. Managing Director
SPECTOMS Engineering Pvt. Ltd.

Educational Background

- BE in Chemical Engineering
- MS in Food Sciened and Technology from University of Georgia, USA
- HACCP Certified

Corporate Role & Tenure

- Mr. Shah serves as a **Jt. Managing Director** of SPECTOMS Engineering Private Limited since **1 December 2009**

SPECTOMS Engineering Pvt. Ltd.

- Founded on **30 April 1974**, the company is based in **Vadodara, Gujarat**, and specializes in the manufacturing of machinery and equipment across sectors like feed, Agro, food processing machinery, marine, defense, and more

Industry Involvement & Leadership

- Mr. Abhay Shah holds a significant position within the **Compound Feed Manufacturers Association of India (CLFMA OF INDIA)** — he has served position in CLFMA OF INDIA as Hon. Secretary and at present he is **Deputy Chairman**, representing SPECTOMS Engineering in the period 2024–26.

Experience in Feed Processing

- With over a decade of expertise in the **feed plant industry**, Mr. Shah has developed substantial technical and managerial acumen in feed processing sectors

REIMAGINING ANIMAL AGRICULTURE IN INDIA: TOWARD SUSTAINABILITY, RESILIENCE, AND RURAL PROSPERITY

Prof. (Dr.) P.K. Shukla*

Introduction

Animal agriculture is a vital component of India's rural economy and food security, providing livelihoods for millions of smallholder farmers and contributing significantly to the nation's agricultural gross value added (GVA). With over 536 million livestock and 851 million poultry, India is home to the world's largest livestock population. With the country being the largest producer of milk, the second-largest producer of eggs, and a key player in global meat production, the livestock sector forms the backbone of rural sustenance. Nearly 70 million rural households, mostly small and marginal farmers, rely on livestock for their livelihood. Despite these impressive figures, the sector faces numerous structural challenges, including low productivity, inadequate animal healthcare, climate change impacts, weak market linkages, and fragmented policies etc.

Current Status of Animal Agriculture in India

India's livestock sector is diverse, encompassing cattle, buffalo, sheep, goats, pigs, poultry, and other animals. According to the 20th Livestock Census (2019), India had 303.76 million bovines (cattle and buffalo), 74.26 million sheep, 148.88 million goats, 9.06 million pigs, and 851.81 million poultry. The sector contributes about 30% to the agricultural GVA and 5.5% to the overall GVA of the country. Dairy is the dominant sub-sector, with India being the world's largest milk producer, but poultry and aquaculture are also growing rapidly, driven by rising demand for animal protein.

Livestock rearing is largely a smallholder enterprise, with over 60% of rural households maintaining large ruminants, primarily for milk and draught power. This decentralized structure has implications for productivity, disease control, and market access.

Key Challenges Facing Animal Agriculture

Low Productivity

Despite the large livestock population, productivity remains a major challenge. The average annual milk yield of Indian cattle is about 1,172 kg, which is only half of the global average. Cattle genetics, poor feeding practices, and limited adoption of advanced breeding techniques are key contributors to this gap. For instance, the average Indian cow produces only three litres of milk per day, compared to 35 litres from US cattle.

Disease Outbreaks

Animal diseases such as Foot and Mouth Disease, Black Quarter, and Influenza are common and cause significant economic losses. Outbreaks reduce productivity, increase mortality, and disrupt supply chains. Limited access to vaccines, veterinary services, and biosecurity measures exacerbates the problem. Animal health remains the major hurdle. Diseases such as Foot-and-Mouth Disease (FMD), Brucellosis, and Peste des Petits Ruminants (PPR) continue to affect large numbers of livestock, especially in underdeveloped regions. Although national vaccination programmes exist, they often suffer from limited reach and poor implementation. Diagnostic infrastructure in rural India is underdeveloped, leaving farmers with little support in detecting and managing diseases in time. This not only reduces productivity but also affects farmer incomes and the safety of animal products.

Environmental Concerns

The livestock sector is increasingly vulnerable to the effects of climate change. Erratic rainfall, extreme temperatures, and frequent droughts have led to shrinking availability of water and green fodder. At the same time, the sector itself contributes to greenhouse gas emissions, particularly methane and nitrous oxide, raising concerns over environmental sustainability. Addressing this dual challenge of climate impact and emissions requires urgent adoption of climate-smart practices in livestock farming. Improper waste management threatens water and air quality. Sustainable waste management and mitigation strategies are urgently needed to address these environmental impacts.

Limited Access to Credit and Markets

The livestock sector receives a disproportionately small share of agricultural credit and public expenditure. Institutional mechanisms for risk management, such as insurance and market access, are weak, leaving smallholders vulnerable to financial shocks and market fluctuations. Another persistent challenge is the poor market infrastructure. Farmers, especially in remote areas, often lack access to reliable transportation, milk collection centres, processing facilities, and cold chains. As a result, they are forced to sell their produce locally at suboptimal prices. The absence of organized markets and fluctuating prices make it difficult for farmers to plan production and manage risks. Additionally, the dominance of middlemen in the supply chain reduces transparency and lowers returns for producers.

Feed and Fodder Scarcity

Rising feed prices and competition for arable land pose challenges for livestock farmers. The diversion of feed and fodder ingredients for industrial use further strains availability, impacting animal health and productivity.

Opportunities for Growth and Transformation

Rising Demand for Animal Protein

India's consumption of meat, dairy, and poultry is expected to nearly double between 2000 and 2030, driven by urbanization, rising incomes, and changing dietary preferences. Poultry and aquaculture are projected to lead this growth, as they are more resource-efficient and have a lower environmental footprint compared to traditional livestock rearing.

Technological Advancements

Digital tools and precision agriculture are transforming animal husbandry. Startups like Stellapps offer digital platforms for milk production monitoring, early disease detection, and quality analysis, empowering dairy farmers with real-time data and decision support. Advanced breeding technologies, including genomic selection and marker-assisted breeding, are improving livestock genetics and accelerating productivity gains.

Government Initiatives and Policy Support

The Indian government has introduced several schemes to modernize the livestock sector. The Revised National Program for Dairy Development (NPDD) and Rashtriya Gokul Mission (RGM) have received significant budgetary allocations to enhance productivity, infrastructure, and market access. These programs focus on breed improvement, disease control, and farmer capacity building.

Financial Inclusion and Risk Management

Government-backed financing options, such as PM Kisan Samman Nidhi, Kisan Credit Cards for animal husbandry, and NABARD subsidies, are expanding access to credit for livestock farmers. Livestock insurance schemes are also becoming more accessible, providing financial security in the face of disease outbreaks and other risks.

Sustainable and Ethical Practices

There is growing interest in sustainable and ethical animal husbandry practices, including organic farming, rotational grazing, and waste management. These practices not only improve farm productivity but also enhance environmental conservation and animal welfare.

To truly transform animal agriculture, a long-term, integrated roadmap is essential. Prioritizing small and marginal livestock farmers is key. They must be empowered with financial access, insurance, extension services, and better market integration. Cluster-based livestock development models that offer breeding, veterinary, nutrition, and marketing services in one ecosystem can dramatically improve efficiency.

Sustainable Practices for Healthy and Productive Livestock

Selective Breeding and Genetic Improvement

Crossbreeding indigenous breeds with exotic stocks has shown limited success due to challenges in quality germplasm and technical manpower. However, ongoing efforts under the Rashtriya Gokul Mission aim to enhance the genetic potential of Indian livestock through breed improvement and conservation of indigenous breeds.

Despite hurdles, there are promising opportunities to revamp animal agriculture in India. One of the key areas is genetic improvement. Scientific breeding using Artificial Insemination (AI), Embryo Transfer Technology (ETT), and genomic selection can enhance productivity while preserving desirable traits. Conservation of indigenous breeds such as Gir, Sahiwal, and Tharparkar is also crucial, given their resilience to diseases and climatic extremes.

Balanced Nutrition and Feed Management

Providing balanced, high-quality feed is essential for improving animal health and productivity. Innovations in feed technology, including the use of micro-organisms and insects as feed sources, are expected to enter the Indian market in the coming years, offering more sustainable and efficient alternatives to traditional feed.

Feed and fodder management is the area with immense scope for improvement. The availability of green and dry fodder is seasonally variable, and many animals suffer from chronic undernutrition. Technologies such as hydroponic green fodder, silage making, and Total Mixed Ration (TMR) can significantly enhance animal health and output. Strengthening supply chains for quality feed, encouraging fodder crops, and promoting dual-purpose varieties (for both grain and fodder) can address this issue.

Healthcare and Disease Management

Strengthening veterinary services, vaccination programs, and biosecurity measures is critical for reducing disease outbreaks and improving livestock health. Digital tools for disease surveillance and early detection can further enhance the effectiveness of these efforts.

Waste Management and Environmental Sustainability

Proper disposal and utilization of animal waste are key to reducing environmental pollution. Manure can be used as organic fertilizer, while biogas production and composting offer additional benefits for soil health and renewable energy generation. Wastewater management is also important for preventing water contamination.

Sustainable livestock systems are crucial for the future. Integrating manure management practices like biogas production and composting can reduce environmental footprints while generating energy and organic fertilizers. Promoting pasture improvement, rotational grazing, and integrated crop-livestock systems can further enhance resource efficiency. Low-emission livestock systems can be encouraged through incentives and training programs at the village level.

Environmental sustainability must not be sidelined. Promoting regenerative livestock practices, restoring degraded grazing lands, and encouraging afforestation are essential for balancing productivity with ecological responsibility. Incentivizing climate-positive actions, such as carbon sequestration through better manure and pasture management, can align farmer welfare with climate goals.

Ethical Animal Husbandry

Ethical practices, such as humane treatment, stress-free handling, and reduced use of antibiotics and hormones, are gaining traction. Protecting

indigenous breeds and promoting rotational grazing help maintain biodiversity and prevent land degradation.

Market and Value Chain

Market and value chain development must go hand in hand with production improvements. In the dairy sector, there is a need to strengthen Farmer Producer Organizations (FPOs), expand milk chilling and processing infrastructure, and facilitate export certification to tap into global markets. For poultry and meat, establishing hygienic slaughterhouses, traceability mechanisms, and cold storage units can improve food safety and export readiness. Supporting smallholders with business training, quality control, and branding opportunities can help them access premium markets.

The Role of Digital Transformation

Technology can also play a transformative role. The use of digital platforms for animal registration (e.g., Pashu Aadhaar), mobile-based disease alerts, remote consultations, and ration balancing tools is already gaining momentum. These innovations bring veterinary services and market information directly to the farmer's fingertips, improving efficiency and reducing dependency on intermediaries

Digital Platforms for Livestock Management

Digital platforms are enabling farmers to monitor animal health, track production, and access market information in real time. These tools improve efficiency, reduce losses, and enhance profitability for smallholders.

Data-Driven Decision Making

Data analytics and artificial intelligence are supporting precision agriculture, enabling farmers to optimize feeding, breeding, and healthcare practices. Pay-as-you-go and lease-based robotics are making automation accessible even to smallholder farmers.

Holistic Digital Identities

By 2030, farmers are expected to have digital identities that encompass land ownership, farm health, and financial profiles. This will facilitate access to credit, insurance, and market linkages, empowering smallholders to scale their operations and manage risks more effectively.

Policy and Institutional Reforms

The Government of India has launched several schemes to promote animal husbandry. The Rashtriya Gokul Mission aims to improve indigenous breeds, while NADCP ensures disease control through free vaccinations. The National Livestock Mission focuses on entrepreneurship and feed development. The Animal Husbandry Infrastructure Development Fund (AHIDF) offers financial support for setting up dairy and meat processing units. These initiatives, combined with increased budget allocations and interest subvention through Kisan Credit Cards, are helping to formalize and strengthen the sector.

Increased Public Investment

The livestock sector has historically received a small share of public expenditure relative to its contribution to agricultural GDP. Increasing investment in infrastructure, research, and extension services is essential for driving productivity gains and sustainability.

Public-private partnerships (PPPs) are another pillar for advancement. Encouraging private investments in animal health services, technology startups, feed innovation, and logistics can improve competitiveness and service delivery. Collaboration between NGOs, academia, and private players can create scalable, innovative models for training, input delivery, and market access.

Strengthening Market Linkages

Improving access to organized markets and value chains is critical for ensuring fair prices and reducing post-harvest losses. Government initiatives to modernize mandis (agricultural markets) and promote e-NAM (National Agriculture Market) are steps in the right direction.

Research and Innovations

Research and development (R&D) also deserve greater investment. District-level veterinary labs, mobile clinics, and advanced research centres focusing on vaccine development, genetic studies, and disease resistance must be scaled up. At the same time, women's participation must be actively promoted. Rural women are often primary caregivers for livestock, yet they remain underrepresented in decision-making. Supporting women-led cooperatives and training programs can increase productivity and gender equity.

One Health Approach

A holistic "One Health" approach is necessary for managing animal health. This integrated strategy considers animal, human, and environmental health as interconnected. Under the National Animal Disease Control Programme (NADCP), mass vaccination against FMD and Brucellosis has been launched. However, for sustainable impact, these programmes need to be complemented by awareness campaigns, regular health monitoring, and improved veterinary infrastructure.

Capacity Building and Extension Services

Training and capacity building for farmers on modern animal husbandry practices, digital tools, and sustainable farming methods are essential for sectoral transformation. Extension services should be strengthened to disseminate best practices and innovations.

Education and capacity building are the foundation of sustainable change. Training programs through veterinary universities, Krishi Vigyan Kendras (KVKs), and digital platforms should focus on upskilling rural youth in livestock care, value addition, and agribusiness management. Integrating livestock education into broader agricultural extension systems can enhance awareness and adoption of best practices.

The Way Forward: Strategies for Sustainable Animal Agriculture

1. Enhancing Productivity Through Technology and Genetics

- **Adopt advanced breeding techniques:** Genomic selection and marker-assisted breeding can accelerate genetic improvement and productivity gains.
- **Promote digital tools:** Encourage the adoption of digital platforms for livestock management, disease surveillance, and market intelligence.
- **Improve feed quality:** Invest in research and innovation for sustainable feed alternatives, including insect-based and microbe-based feeds.

2. Strengthening Disease Control and Biosecurity

- **Expand vaccination programs:** Ensure widespread access to vaccines and veterinary services.
- **Enhance disease surveillance:** Use digital tools for early detection and rapid response to outbreaks.
- **Promote biosecurity measures:** Educate farmers on best practices for preventing disease transmission.

3. Promoting Sustainable and Ethical Practices

- **Adopt organic and rotational grazing:** Encourage sustainable farming methods that protect soil health and biodiversity.
- **Improve waste management:** Promote manure utilization, biogas production, and composting to reduce environmental impact.
- **Ensure humane treatment:** Implement standards for animal welfare and reduce the use of harmful chemicals.

4. Expanding Access to Credit and Insurance

- **Increase financial inclusion:** Expand access to credit, insurance, and risk management tools for livestock farmers.
- **Leverage government schemes:** Promote

awareness and uptake of government-backed financing and insurance schemes.

5. Strengthening Market Linkages and Value Chains

- **Modernize market infrastructure:** Invest in cold chains, processing facilities, and digital market platforms.
- **Promote value-added products:** Encourage the production and export of processed dairy, meat, and poultry products.

6. Building Climate Resilience

- **Develop climate-smart breeds:** Invest in research to develop livestock breeds that are resilient to heat stress and disease.
- **Promote sustainable feed and water management:** Encourage practices that reduce water and land use intensity.

Conclusion

Animal agriculture in India stands at a crossroads, with immense potential for growth and transformation. Addressing the challenges of low productivity, disease outbreaks, environmental impact, and limited access to credit and markets will require a multi-pronged approach that leverages technology, policy reforms, and sustainable practices. By embracing digital transformation, strengthening disease control, promoting ethical and sustainable farming, and expanding financial inclusion, India can ensure the long-term viability and prosperity of its livestock sector. The way forward lies in innovation, collaboration, and a shared commitment to building a resilient and sustainable animal agriculture system that benefits farmers, consumers, and the environment alike.

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GLOBAL TRENDS IN POULTRY

G. CHANDRASHEKHAR

The Indian livestock sector has emerged as a significant engine of growth in agriculture, playing a vital role in the overall agricultural landscape. Its importance is underscored by a remarkable increase in its contribution to the Gross Value Added (GVA) of agriculture and related sectors, which surged from 24.4 per cent in the fiscal year FY15 to an impressive 30.2 per cent by FY23.

In the latter year, the livestock sector alone represented 5.5 per cent of the total GVA, reflecting its dynamic growth trajectory, with a robust CAGR of 13 per cent.

The economic significance of this sector is illustrated by its escalating output value, which reached an astounding Rupees 17.25 lakh crore (equivalent to US$ 205.81 billion) in FY23. Among the various branches of livestock production, the milk industry stands out, generating over Rs 11.16 lakh crore (US$ 133.16 billion) in revenue. This figure highlights the sector's vitality and reveals its dominance, eclipsing the aggregate production value of staple crops like paddy and wheat.

The livestock sector is thus not just a contributor to the economy; it is a cornerstone of agricultural prosperity and food security, propelling the rural economy and livelihoods along the way.

Coming to the poultry sector, global poultry consumption is projected to reach 173 million tons ready-to-cook (rtc) by 2034, accounting for 62 percent of the additional meat consumed globally. The increase in poultry meat consumption in the last decade was driven by rising consumption in Asia, especially in China, India, Indonesia, Pakistan and Viet Nam. This trend is expected to continue, with rapid consumption growth also projected in other regions such as Brazil, Egypt, Mexico, the Philippines, and the United States, according to OECD-FAO.

The global increase in protein from poultry meat consumption as a share of total protein from meat has been the main feature of the growth in meat consumption for decades, and this trend is expected to continue. By 2034, poultry meat will provide 45 percent of the protein consumed from all meat sources. This is due to several factors, notably its low cost (poultry remains the most affordable meat) and its favourable nutritional profile with a higher protein-to-fat ratio compared to other meats.

Environmental considerations also contribute to the shift towards poultry meat, as the production of red meat is more resource-intensive and leads to higher greenhouse gas emissions. Poultry is, therefore, more appealing to sustainability-conscious consumers.

Poultry will expand its dominance within the meat complex, accounting for 62 percent of the additional meat produced in the next decade. Driven by domestic demand, poultry production will expand most rapidly in upper middle-income countries. Poultry has advantages over other meats in terms of short production cycles, high feed conversion efficiency (yielding more meat per unit of feed), lower overall production costs, and the ability to be raised close to rapidly urbanising markets.

Nevertheless, several factors will constrain the growth of the sector. In particular, the incidence of HPAI outbreaks has been spreading. Higher densities of poultry production increase the risk of disease outbreaks and although improved

surveillance and containment can limit impacts, they also raise industry costs (e.g. biosecurity investments, vaccination campaigns). Poultry production also faces environmental and health challenges, particularly regarding antibiotic use and animal welfare concerns.

The global meat sector is facing increasing pressures on multiple fronts. In recent years, producers worldwide have contended with high input costs, increasingly stringent environmental and animal health regulations, and various disease outbreaks. Feed costs, which spiked in the early 2020s, have since moderated, but other operating and labour expenses continue to rise. In response, the sector is increasingly focused on raising productivity through improved breeding techniques, better herd and flock management and higher slaughter weights. These improvements are essential not only for cost management, but also for enhancing sustainability in the face of competitive pressures from alternative protein sources.

Biosecurity stands as a critical concern for the meat industry

The meat sector faces a multitude of uncertainties, chief among them being the evolution of animal disease outbreaks, shifts in environmental policies, changes in trade policies, rising economic uncertainties and changing consumer preferences concerning diet and health, and animal welfare.

Seasonal shocks, such as droughts and floods, can reduce feed grain harvests or water supplies, driving up production costs and constraining meat output. Increasing weather fluctuations will also affect on-farm productivity. Moreover, policies such as carbon pricing and manure management rules, or restrictions aimed at reducing GHG emissions from livestock could raise production costs. Compliance with such regulations might require investments that slow output growth. Emission reduction commitments in some countries may deliberately limit livestock expansion by capping herd sizes or incentivising lower-emission farming, for example, to curb emissions.

Finally, international trade plays a vital role in the meat sector, and changes in trade policies such as tariffs and trade bans can also significantly impact national and global markets. After several decades of more liberal trade, recent tendencies toward more protectionism could reduce trade and generally lower prices in international trade, as domestic prices increase with higher trade barriers.

(G. Chandrashekhar is senior editor and policy commentator)

ENSILING PADDY STRAW
AN EXCELLENT ALTERNATE TO BURNING

Dr M R Garg

Abstract

About 500 million tonnes of crop residues are generated annually in India, with highest generation in Uttar Pradesh (60 million tonnes) followed by Punjab (51 million tonnes). Out of these, about 90 million tonnes of paddy straw are disposed of by burning, which not only contributes to greenhouse gas emissions but also enhances the bar of fodder shortage in the country. Limited time-window between paddy harvesting and sowing of wheat crop is one of the major reasons that enforces the farmers for burning of paddy straw. Any intervention for immediate collection of freshly harvested paddy stubbles from the farmers' field and conserving them in the form of silage using lactobacillus culture and multi-enzymes could help to avoid burning of paddy straw. Though, feeding of paddy straw as-such is not prevalent in north India, enriched paddy stubble silage could be popularized, and surplus silage could be transported to nearby fodder deficit states. A large-scale initiative in this direction, which appears to be country and context specific, farmer centric, science based and pragmatic synergistic could be a promising approach for addressing the triple-burning issues of the country; *crop residue burning, fodder scarcity and climate change.*

Introduction

India, the second largest agro-based economy generates a large amount of agricultural waste, including crop residues. The increase in availability of crop residues over the years has largely been due to increase in production of paddy, wheat and other field crops resulting in higher grain production and consequently higher availability of crop residues from these crops. Crop residues are field residues that remain in an agricultural field after the crop is harvested commonly include stalks and stubble (stems), leaves and seed pods. This crop residues serve as an important source of roughage, which meet the partial requirements of livestock. It has been reported that crop residues constitute a major source of fodder (54%) for livestock feeding in India (Hegde, 2006). Although these crop residues are considered as valuable by the livestock keepers, there has been a lot of wastage in many parts of the country.

Major crop residues available in North India are paddy straw and wheat straw due to adoption of Rice-Wheat cropping systems in large area. This cropping system is prevalent in northern region mainly due to suitable agro-climatic conditions for cultivation, optimum MSP and largescale procurement of grains by public/private sector agencies. However due to lack of demand in local markets, paddy straw is being burnt by the farmers in Punjab, Haryana and Uttar Pradesh states. Burning of paddy straw not only contributes to greenhouse gas (GHG) emissions, but also widens the gap between demand and supply of livestock forages in the country.

In past, various physical, chemical and biological methods have been tried for improving the utilization of straws as livestock feeding (Sarnklong et al., 2010). However, most of these methods are not practically and commercially applicable by the dairy/agriculture farmers under field conditions owing to their various limitations. Despite efforts by different agencies, paddy straw is being burnt after combine harvesting, mainly due to limited window for clearing the fields for sowing wheat crop after harvesting of paddy crop. Any

attempts for immediate collection of freshly harvested biomass from the field and conserving them in the form of silage would provide a promising approach for control of residue burning and help improving the availability of fodder for livestock feeding. Further, this highly compacted/densified ensiled residue could be transported to nearby fodder deficit states.

Aim of this article is to create awareness amongst entrepreneurs/decision makers/fodder plus Farmer Producer Organizations (FPOs)/ academician /progressive dairy farmers/NGOs about the current status and potential use of crop residues as feeding for cows and buffaloes in north region.

Status of crop residues in North India

India produces about 500 million tonnes (MT) of straws/stovers annually (ICFA, 2022). The generation of crop residues is highest in Uttar Pradesh (60 MT), followed by Punjab (51 MT) and Maharashtra (46 MT). Among different crops, cereals generate maximum residues (352 MT), followed by fibers (66 MT), oilseeds (29 MT), pulses (13 MT) and sugarcane (12 MT). In India, approximately 90 million tonnes of paddy straw are disposed of by burning. It is estimated that paddy is being cultivated in 30 lakh hectare area in Punjab and about 50 quintals of wet paddy biomass is generated per hectare (Agri and Food Technology Fair, 2022). Around 75-80% of the area under paddy is machine-harvested, and approximately 95% of paddy straw is burnt annually in the state (Singh et al., 2018). The farmers in Punjab, mainly use wheat straw as dry fodder so most of the paddy straw is surplus. A survey on the end-use of rice and wheat straws in the state of Punjab showed that less than 10 percent of rice straw and 40 percent of wheat straw produced annually is used as animal feed.

Burning of crop residues

Burning of crop residues in India is a well-recognised problem, arising and increasing since the late 1980s (Sarkar et al., 2018). The rapid introduction of combine harvesters constitutes a game changer because of the less time spent in crop harvesting in comparison to manual harvesting. Manual collection of straw in the field is uneconomical due to the high labour cost. But use of combine harvesters lead to larger amounts of straw that are left spread out on the field. Most of the farmers burn these straws in the field, mainly due to higher labour cost, lack of availability of equipment for straw collection, sufficient availability of wheat straw for feeding, limited time-window between paddy harvesting and sowing of wheat crop, and the lack of awareness about use of paddy straw for livestock feeding. Rice, wheat and sugarcane crop residue burning together contribute more than 80% of the total biomass burning from different crops in India (**Fig.1**). Any intervention targeted at arresting the residue burning in these crops will significantly reduce this menace.

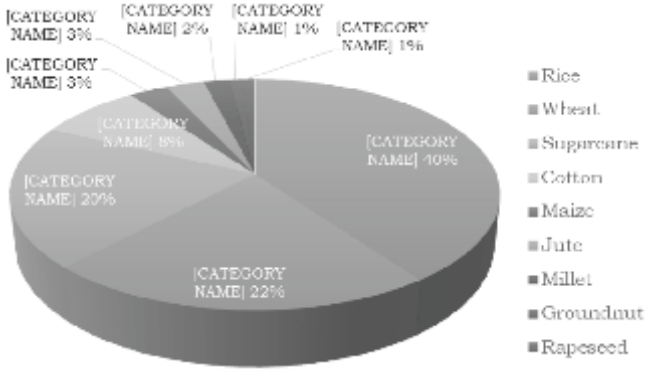

Fig. 1: Contribution of different crops in residue burning (Source: Ministry of New & Renewal Energy, GoI)

At present, North India finds itself in the midst of a paradoxical situation of prodigious production of paddy and wheat (food grains) for meeting the country's food security needs, co-existing with increasing problem of straw disposal. About 85-90 percent of this paddy straw is burnt in the fields, and to some extent, wheat straw is also being burnt during the rabi harvesting season. States like Uttar Pradesh, Punjab and Rajasthan are the epicentres of maximum crop residue burning in North India **(Photo 1)**. The farmers resort to burning of paddy straw as the window between harvesting of paddy and sowing of wheat is of just 2-3 weeks which does not allow for time consuming operations of clearing paddy straw from the fields. The major challenge currently to the states is to effectively handling the problem of crop residue burning.

Use of paddy straw as feeding

Many benefits are also forgone when residues are burned – such as their use as animal feed; construction material; to produce ethanol, or for soil quality and nutrient retention by tilling left-over residues back into the soil (Gupta, 2019). Considering the current fodder scenario in the country, use of paddy straw as such or with enrichment would be more beneficial for dairy farmers. A large-scale attempt for collection of green paddy stubble from the farmers' field immediate after harvest, and ensiling them with enzymes and/silage culture appears to be a promising alternative to residue burning in North India.

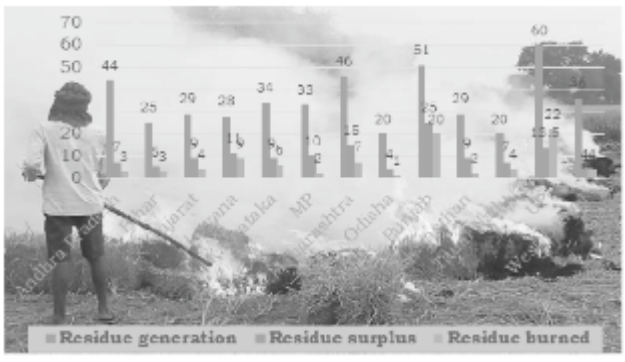

Photo 1: Status of crop residue generation and burning (million tonnes) (Source: Ministry of New & Renewal Energy, GoI)

Feeding to ruminants

The feeding of paddy straw as such to ruminants is not commonly practiced by the farmers in North India. However, it has been documented that the paddy straw can be fed up to 60% in combinations with other feed ingredients such as concentrates, molasses, or legumes to improve palatability, protein content, and intake and digestibility by the animals (Aquino et al., 2020). Average dry matter digestibility (DMD) of paddy straw ranges from 45 to 50% in ruminants. The leaf and stem ratio is essential when it comes to the digestibility of cereal straw. Relatively, paddy straw has a higher proportion of leaves (60%) compared with other cereal straw, such as barley (35%) and oats (43%) (Sarnklong et al. 2010). Having this high proportion of leaves to stems promotes lower in vitro DMD of the leaves at 50–51% compared to the stems at 61% (Vadiveloo, 2000).

Devendra (1997) reported that the amount of paddy straw that ruminants can consume can be as high as 1.2 kg (DM)/100 kg of live weight/day. Paddy straw intake, however, varies among animals and is also influenced by the proportion used in the ration. The intake of paddy straw also varies according to the manner in which it is prepared, processed, and fed to the animals. Physical processing (chopping) or the use of chemical or microbiological treatments considerably improves an animal's paddy straw intake. When offered as is, paddy straw intake is lower because it is bulky or occupies more space in the rumen. Average bulk density of loose and processed paddy straw is given in **Table 1.**

Table 1. Bulk density of loose and processed paddy straw

Paddy straw	Bulk density (kg/m^3 DM)
Loose paddy straw	13 – 18
Chopped paddy straw (2-10 mm)	50 – 120
Paddy straw Bale	60 – 90
Paddy straw Briquettes	350 – 450
Paddy straw Pellets	600 – 700

Source: Aquino et al., 2020.

Processed straws as feeding

Paddy straw could be used for livestock feeding by densifying it with essential nutrients, making silage/pellets/blocks/Total Mixed Ration (TMR). These enriched straw silage/pellets/blocks/TMR from surplus region could be transported to nearby fodder deficit states, where it could take care of the total needs of ruminant feeds/fodder. The nutritive value of these straw can be improved by using various treatments of straw such as physical (soaking & wetting, chopping, grinding & pelleting, steaming under pressure, gamma irradiation), chemical (alkali spray treatment, ammonization of straw, calcium hydroxide treatment, treatment with oxidative reagents, treatment with acids) and biological treatments (white-rot fungi treatment, treatment with enzymes). Many of these processes are technologically feasible and are also economically viable under field conditions. However, due to lack of extension activities, many of these technologies

did not reach to the farmers' doorstep. One of the most promising approaches is to secure the wet/green paddy stubble from the farmers' field immediate after harvest and ensile them with ligno-cellulose degrading enzymes and/Lactobacillus based silage culture.

Paddy stubble silage

In Punjab, small scale studies for making silage from green paddy stubbles were undertaken+. Green paddy stubbles were collected from the field immediate after harvesting, chopped and treated with silage culture (*Lactobacillus plantarum*) @ 1.0, 2.0 and 3.0 g per tonne. Treated paddy stubble was tightly compacted manually and filled in HDPE silage bags (40 kg capacity). After 30 days of incubation period, bags were opened and silage samples were analysed. It was found that a good quality silage (pH 4.4 with very good aroma) from green paddy stubble can be prepared using 3.0 g silage culture per tonne. In another study, chopped paddy stubble was treated with silage culture (@ 1.0, 2.0, 3.0 g per tonne) and multi-enzyme (@ 0.5, 1.0 litre per tonne) in different combinations. Stubbles were round baled (50 kg weight) with the help of baler-wrapper machine and ensiled for 60 days. Results indicated that 2.0 g silage culture and 1.0 litre multi-enzyme per tonne were effective for making a good quality (pH 4.1) paddy stubble silage. Feeding of paddy stubble silage was palatable by the cattle. More studies are required for evaluating the impact of feeding paddy stubble silage on milk production, reproduction and health in dairy animals.

Large-scale initiative

Unpredicted sky-high prices of dry fodder are very common in different seasons as well as in different parts of the country. During recent past, the market price of dry fodder shoot-up significantly and resulted in hardship to rural milk producers, whose livelihood are dependent on livestock and thereby adversely affected profitability of dairy farms. In such situation, paddy stubble silage could be an alternative source of livestock feeding. Large-scale initiative for collection of paddy stubbles from the farmers' field immediately after the harvest, ensiling them with silage cultures and enzymes at organized places could be a promising intervention for avoiding crop residue burning. The surplus paddy stubble silage could also be transported to adjoining fodder deficit states, which would help addressing the fodder shortage in the country.

Fodder-Plus Farmer Producer Organizations (FPOs) working in the northern region could be instrumentals in establishing forward and backward linkages for production and distribution of paddy stubbles silage. This would encourage the farmers to prevent burning of crop residue and would help unlocking the potential for livestock fodder. Further, decision makers/ young entrepreneurs/ progressive dairy farmers/NGOs could join hands together for addressing the triple-burning issues; crop residue burning, fodder shortage and climate change for the betterment of future life.

Avoiding GHG emissions by diverting straws from burning to feeding

Burning of crop residues contribute to greenhouse gas (GHG) emissions – causing global warming (Fagodiya et al., 2017). It also contributes air pollutants – namely, carbon monoxide, oxides of sulphur, oxides of nitrogen, ammonia, non-methane volatile organic compounds, polycyclic aromatic hydrocarbons, elemental carbon, organic carbon and particulate matter and smoke – causing air pollution and thereby causing threats to human health (Jain et al., 2014). Out of the total gases emitted from crop residue burning in India, almost 66% is carbon monoxide (ICFA, 2022).

Crop residue burning is also a major source of black carbon (BC) in the environment. Crop residue burning, particularly within Punjab and Haryana states is an important source of BC that forms the South Asian brown cloud (Bikkina et al., 2019). During the dry and high-loading winter period, when a lot of residue burning takes place, westerly winds push BC along the Indo-Gangetic Plains, with air quality impacts felt in the national capital; Delhi (Bikkina et al., 2019). It has been estimated that BC emission from residue burning ranges between 27 to 83 Gg annually for the whole of India, and 1.5 to 47.2 Gg for Punjab (Andrea et al., 2022). Based on the average emission coefficient for burning of paddy straw and wheat straw (**Table 2**), millions of tonnes of GHG emissions could be

reduced just by diverting the straw from burning to animal feeding.

Table 2: Emission coefficient (g/kg) for residue burning

Parameters	Rice straw	Wheat straw
Methane (CH_4)	9.59	3.55
Carbon dioxide (CO_2)	1177	1787
Carbon monoxide (CO)	93	28
Ammonia (NH_3)	4.1	1.3
Sulfur dioxide (SO_2)	0.18	0.40
Oxide of nitrogen (NO_x)	2.28	1.7

Source: Chethan et al., 2020

Conclusion

Country and context specific approach such as immediate collection of freshly harvested crop residues from the farmers' field and ensiling them with enzymes and silage culture could be a game-changer for avoiding crop residue burning and thereby unlocking the potential for livestock fodder in an environmentally sustainable manner.

Ex Head & General Manager (NDDB)

EMPOWERING WOMEN THROUGH POULTRY-BASED LIVELIHOODS

Kaushalendra Kumar

Introduction

In rural India, among all livestock activities, backyard poultry farming stands out as an accessible, low-investment, and high-impact livelihood option for rural women. It not only supplements household income but also enhances food and nutritional security, improves the socio-economic status of women, and promotes gender equity. Women play a pivotal role in rural development, yet they often remain marginalized in economic activities. Backyard poultry farming has emerged as a viable and inclusive livelihood option that empowers women socially and economically. It requires low investment, fits easily into daily household routines, and offers significant returns in terms of income, nutrition, and autonomy. Backyard poultry farming serves as a gateway to economic independence for rural women, particularly in low-income and resource-poor households.

Significance of backyard poultry for women:

- Low entry barrier: Requires minimal land, capital, and labor, making it ideal for landless and marginalized women. Birds can scavenge in the open, reducing dependence on purchased feed.
- Flexible workload: Fits well with women's daily routine and household responsibilities.
- Fast returns: Provides quick income through frequent egg-laying and short growth cycles.
- Nutritional access: Eggs and meat are consumed within the household, improving dietary diversity.

Economic empowerment:

- Women can earn Rs. 3,000 to 7,000 per month through small poultry units (10 - 30 birds).
- Income diversification reduces reliance on seasonal agriculture.
- Profits can be reinvested in education, health, or further poultry expansion.
- Regular income helps meet day-to-day needs such as food, education, and healthcare.
- Encourages bank linkages and builds women's creditworthiness over time.
- Encourages micro-entrepreneurship and self-reliance among rural women.
- Participation in Self-Help Groups (SHGs) or poultry cooperatives facilitates savings, credit access, and reinvestment in microenterprises.
- It provides supplementary income, reducing dependence on seasonal agricultural labor or remittances.
- Poultry farming acts as a safety net in times of crop failure, drought, or other income shocks.
- Women can expand into value-added enterprises, such as chick rearing units, egg collection and grading centers, poultry feed preparation and sale, slaughter and dressed meat sales

Social empowerment:

- Increased decision-making power in family

and community affairs. Their role in income generation strengthens their voice in household matters, shifting them from passive dependents to active contributors.

- Enhanced self-esteem and leadership through group formation and SHG activities. Participation in training, meetings, and community events increases their social mobility and communication skills.

- Reduced gender disparities in resource ownership and livelihood opportunities. Women who successfully run poultry units are often viewed as role models, earning social respect.

- Participation in village-level poultry cooperatives fosters community bonding. By earning income and participating in community networks, women challenge traditional norms that limit their public presence and economic activity.

- Exposure to local markets, input suppliers, and buyers improves women's economic engagement and negotiation abilities.

Role of women-centric models and institutions:

It ensures gender-sensitive planning and implementation, addresses specific needs and constraints of women (mobility, access to credit, land ownership). Facilitates group-based empowerment and shared learning, builds social capital and collective bargaining power.

- ***Self-Help Groups (SHGs)***: A small, informal groups of 10–20 women managing savings and credit collectively. SHGs serve as entry points for training, chick distribution, feed supply, and marketing. It promotes financial literacy, entrepreneurship, and peer support. This leadership builds a pipeline of grassroots women leaders for rural governance.

- ***Pashu Sakhi Model:*** Community-based livestock service providers trained to offer basic veterinary care, vaccination, feeding advice, etc. Run by rural women, often from SHGs or federations. Pashu Sakhis generate income while providing services to other women farmers, enhancing their leadership and visibility.

- ***Women-led Producer Groups and Cooperatives:*** Organized structures for collective poultry rearing, feed procurement, and egg/meat marketing. Help in reducing costs, improving scale, and ensuring fair market prices. Examples include Kudumbashree Broiler Project (Kerala), Poultry Producer Companies under JEEViKA (Bihar) and PRADAN's women's poultry collectives (Jharkhand, Odisha)

- ***Community Resource Persons (CRPs) and Master Trainers:*** Experienced women trained as resource persons to train other SHG members. Help scale up poultry practices and ensure quality at the community level.

- ***Integration with National Missions:*** DAY-NRLM (Deendayal Antyodaya Yojana–National Rural Livelihood Mission) supports SHGs and livelihoods like poultry through capacity building, credit, and convergence with other schemes. National Livestock Mission (NLM) focuses on backyard poultry and livestock-based livelihood for women.

Improved breeds and technologies:

Backyard poultry farming in India has traditionally relied on indigenous, low-producing birds. However, the introduction of improved dual-purpose breeds and appropriate technologies has revolutionized rural poultry, especially in the hands of women. These interventions lead to higher productivity, better income, and improved nutritional security while maintaining adaptability to village conditions. Indigenous birds typically lay 50-70 eggs/year and have poor growth rates. But improved backyard breeds offer higher egg production (150–250 eggs/year), better body weight gain, early maturity and resistance to local climatic stress and diseases. Commonly used improved backyard poultry breeds in India are Vanaraja, Gramapriya, Kuroiler, Chabro, Jharsim, Narmadanidhi, Hitcari, Sonali, etc. Mobile-based advisory services, vaccination kits, and portable

poultry units empower women with knowledge and tools.

Challenges faced by women in poultry livelihoods:

While backyard poultry is recognized as a promising livelihood option for rural women, several challenges limit its full potential. These barriers range from lack of access to inputs and services to deep-rooted gender norms. Addressing these challenges is critical for transforming poultry into a sustainable and empowering activity for women.

- ***Limited Access to Quality Inputs:*** Difficulty in accessing day-old chicks, quality feed, and vaccines due to poor last-mile delivery. Lack of availability of improved breeds in rural and tribal areas.

- ***Inadequate Veterinary and Extension Services:*** Insufficient availability of trained veterinarians or paravets in remote villages. Limited knowledge on vaccination schedules, disease management, and scientific rearing practices. Extension services often fail to reach women directly due to male-dominated systems. Dependence on middlemen increases costs and reduces quality assurance.

- ***Financial Barriers:*** Lack of collateral-free credit and poor access to formal finance. Limited participation in banking systems and low financial literacy among rural women. Irregular income flow from poultry makes it hard to secure loans or plan investments.

- ***Gender-Based Social Constraints:*** Cultural norms and mobility restrictions hinder women's ability to attend training, markets, or meetings. Male dominance in household decisions often prevents women from controlling poultry income. Lack of recognition of women's work in livestock sectors by community and policymakers.

- ***Market Access and Value Chain Exclusion:*** Women have poor access to organized markets; they mostly sell at local unregulated markets at low prices. Lack of knowledge on pricing, negotiation, and grading of poultry products. Minimal involvement in value-added activities like meat processing, packaging, or branding.

- ***Climate and Disease Vulnerability:*** Birds are exposed to extreme weather (heat/cold/rain), increasing mortality in poorly protected shelters. High susceptibility to Ranikhet, fowl pox, and coccidiosis, especially when proper vaccination is missing. Disease outbreaks often wipe out entire flocks, with no access to insurance or compensation.

- ***Lack of Training and Capacity Building:*** Few women-focused training programs on poultry management or business planning. When training exists, language, timing, or male-led delivery limits participation. Need for practical, hands-on learning rather than theoretical sessions.

- ***Weak Institutional Support:*** Fragmented coordination between departments (Animal Husbandry, Rural Development, Women & Child Welfare). Insufficient follow-up and monitoring after input distribution or training. Lack of policy-level gender targeting in poultry development schemes.

Way forward for addressing the challenges:

- Capacity building in health, nutrition, and enterprise management.

- Promote women-led input centers and hatcheries at village/block levels.

- Train and support Pashu Sakhis and women extension workers.

- Formation of women poultry clusters or cooperatives for collective bargaining.

- Design gender-sensitive policies with direct benefit transfer to women farmers.

- Provide access to microfinance, insurance, and digital tools for better planning.

- Build inclusive poultry value chains with

stronger market linkages and branding support for rural women.

- Digital extension services in local languages for rural women.

Conclusion:

Backyard poultry is a powerful tool for economic empowerment of rural women. It not only generates income but also builds confidence, improves financial autonomy, social empowerment and promotes micro-entrepreneurship. With proper institutional support and training, poultry farming can transform women from passive laborers into active earners, decision-makers, and leaders in their communities.

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NUTRITIONAL INTERVENTIONS TO IMPROVE FERTILITY IN MALE CHICKEN

Jyoti Palod[1], Roshni Chand[2] and Vidyasagar Singh[1]

1. Introduction

The relentless growth of the global poultry industry necessitates a continuous focus on optimizing every facet of production, with reproductive performance standing as a cornerstone of economic sustainability. Within broiler breeder operations, the male rooster serves a disproportionately critical role, as a single individual is typically responsible for fertilizing the eggs from 8 to 10 females (Bakst, 2011). A single male can fertilize over 1,000 eggs annually (Wu *et al.*, 2017). This numerical disparity underscores male fertility as an undeniable linchpin for overall flock reproductive success and, consequently, the hatchability of fertile eggs. Any compromise in male fertility can lead to substantial economic losses due to reduced chick output and inefficient resource utilization (Fouad *et al.*, 2020).Historically, intensive genetic selection in broiler breeders has primarily focused on rapid growth rates and improved feed conversion efficiency, often inadvertently leading to an imbalance between robust production performance and sustained reproductive capacity (Sasanami *et al.*, 2013). This imbalance has brought to light the pressing need for tailored management and nutritional strategies to support the reproductive health of male chicken.Nutrition, uniquely, emerges as a highly modifiable and impactful factor influencing male reproductive health. The complex processes of spermatogenesis (the generation of sperm and the maintenance of optimal sperm quality) are highly energy-intensive and metabolically demanding. Furthermore, these biological pathways are exquisitely sensitive to the availability of essential nutrients and susceptible to the damaging effects of oxidative stress. Recent scientific investigations have unequivocally demonstrated that specific nutritional interventions possess the capacity to modulate critical semen characteristics, enhance sperm motility, improve testicular functionality, and regulate key reproductive hormone levels (Arscott *et al.*,1965; Fouad *et al*., 2020; Zhang *et al*., 2023).

This paper comprehensively explores how nutritional interventions enhance fertility in male chicken, focusing on the roles of macro and micronutrients in reproductive physiology. It also highlights recent research advances, practical challenges, and future directions for industrial application.By optimizing the nutritional intake of male chicken, the industry can significantly contribute to enhanced reproductive performance, improved flock productivity, and ultimately, increased profitability within the poultry sector.

2. Role of Nutrition in Male Reproductive Physiology

Achieving optimal fertility in roosters hinges upon a delicate balance of successful sperm production (spermatogenesis), the quality and functional integrity of the spermatozoa, and effective mating behaviour. Spermatogenesis, the intricate process of germ cell differentiation and maturation, occurs within the seminiferous tubules of the testes. It involves a series of precisely orchestrated mitotic and meiotic divisions, leading to the formation of immature spermatids, which then undergo spermiogenesis to transform into mature spermatozoa. Subsequently, these spermatozoa undergo further maturation and acquire full motility and fertilizing capacity within the epididymis before being stored in the vas deferens (Sasanami *et al*., 2013).

The nutritional status of the male chicken profoundly influences several critical aspects of its reproductive physiology:

2.1. Spermatogenesis and Testicular Development: Adequate provision of energy, protein, and specific micronutrients is fundamental for the proliferation and differentiation of germ cells, the structural integrity of the seminiferous tubules, and the overall development and maintenance of testicular tissue. Nutritional deficiencies can lead to hypoplasia or degeneration of the testes, directly impairing sperm production.

2.2. Semen Volume and Sperm Concentration: The quantity of semen produced and the concentration of viable spermatozoa per unit volume are directly influenced by the availability of building blocks and energy for spermatogenesis and seminal fluid production.

2.3. Sperm Motility and Membrane Integrity: Sperm motility, a critical determinant of fertilizing ability, is highly energy-dependent and relies on the structural integrity and fluidity of the sperm plasma membrane. Specific fatty acids and antioxidants play pivotal roles in maintaining this integrity and protecting against damage.

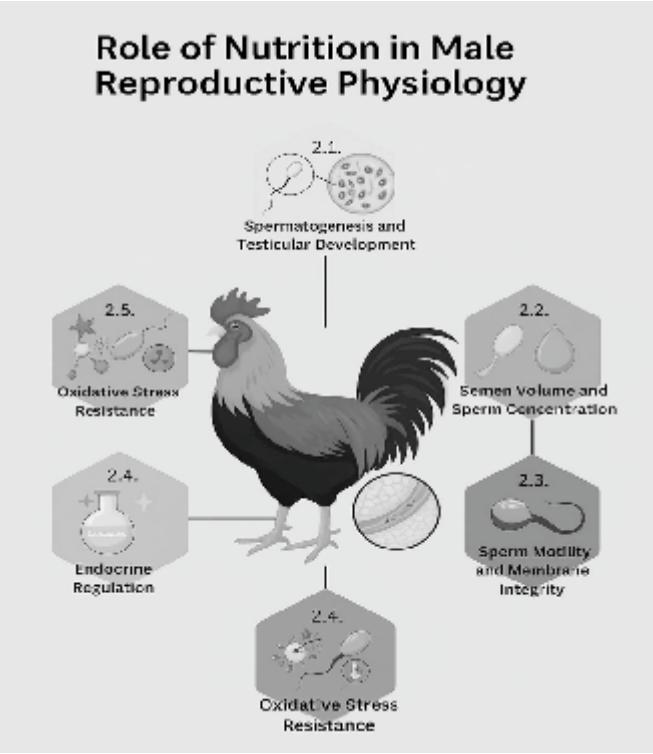

Fig. 1 Role of Nutrition in Male Reproductive Physiology

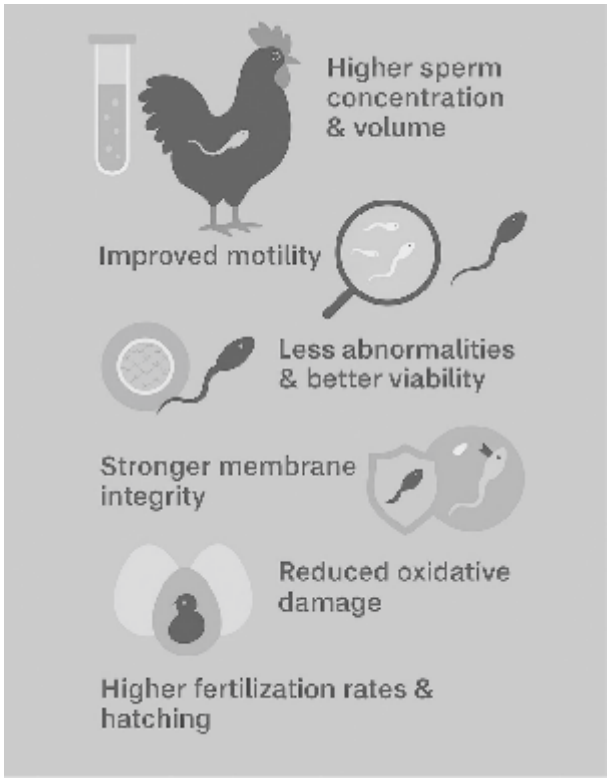

Fig. 2 Impact of nutritional interventions on key sperm quality parameters

2.4. Endocrine Regulation (Testosterone Production): The hypothalamic-pituitary-gonadal axis governs male reproductive hormone production, primarily testosterone, which is essential for spermatogenesis and the development of secondary sexual characteristics. Nutrients such as zinc, cholesterol (for steroid synthesis), and certain vitamins are involved in the synthesis and regulation of these hormones.

2.5. Oxidative Stress Resistance: The process of spermatogenesis, coupled with the high content of polyunsaturated fatty acids (PUFAs) in sperm membranes, makes spermatozoa particularly vulnerable to oxidative stress. An imbalance between the production of reactive oxygen species (ROS) and the capacity of the antioxidant defence system can lead to lipid peroxidation of sperm membranes, DNA damage, reduced motility, and compromised viability. Nutrition plays a crucial role in bolstering these endogenous antioxidant defences.

Ultimately, any inadequacy or imbalance in the diet, whether due to chronic undernutrition or

specific nutrient deficiencies, can disrupt these intricate physiological processes, resulting in subfertility or outright infertility, thereby compromising the economic efficiency of the poultry breeding enterprise.

3. Key Nutritional Interventions

Optimizing male chicken fertility through nutrition involves a targeted approach that considers the specific roles of various macro and micronutrients.

3.1. Vitamins

Vitamins, serving as vital coenzymes and antioxidants, are indispensable for male reproductive health.

3.1.1. Vitamin E (Tocopherols): A key lipid-soluble antioxidant, protects sperm plasma membranes from oxidative damage by neutralizing free radicals and halting lipid peroxidation in their PUFA-rich structure. By enhancing mitochondrial function and preserving membrane integrity, it improves sperm viability and motility (Asl *et al.*, 2018).Supplementation with Vitamin E, typically within a range of 100–200 mg/kg of feed, has consistently demonstrated efficacy in enhancing semen quality parameters, including significant improvements in sperm motility, viability, and concentration, while simultaneously reducing lipid peroxidation in sperm cells (Fouad *et al*., 2020). Deficit of vitamin E slowed the maturation of the reproductive organs (cloacal gland and testes) and lowered foam production in quails(Hooda *et al*., 2007).Supplementing quail diets with 150 mg/kg of Vitamin E increased sperm Vitamin E levels, reduced lipid peroxidation, and significantly improved fertility by enhancing testis and cloacal gland development, foam production, semen quality, and sperm viability and motility, while reducing dead and abnormal sperm (Biswas *et al.,* 2007; Adabi *et al*., 2011). Furthermore, Supplementing Lohmann Brown breeder roosters with 100 mg/kg of Vitamin E improved semen volume, sperm concentration, and forward motility(Danikowski *et al.*, 2002).Its mechanism involves scavenging free radicals and preventing the chain reaction of lipid oxidation within the polyunsaturated fatty acid-rich sperm membranes.

3.1.2. Vitamin A (Retinol): Essential for maintaining the health and integrity of epithelial tissues throughout the body, including those lining the reproductive tract. More critically, retinoic acid, a metabolically active derivative of Vitamin A, is an absolute requirement for normal spermatogenesis. It plays a pivotal role in the differentiation and maturation of germ cells within the seminiferous tubules. Deficiencies can lead to severe impairment of sperm production and testicular atrophy.

3.1.3. Vitamin C (Ascorbic Acid): As a potent water-soluble antioxidant, Vitamin C works synergistically with Vitamin E by regenerating its oxidized form, thereby extending its antioxidant capacity. Furthermore, Vitamin C directly neutralizes various free radicals. Supplementation with Vitamin C has been shown to reduce oxidative damage and significantly improve sperm viability, especially under challenging environmental conditions such as heat stress, which inherently increases oxidative burden. While chicken can synthesize Vitamin C, additional dietary provision can enhance their overall antioxidant defence system during periods of high physiological demand or stress.

3.1.4. Vitamin D3 (Cholecalciferol): Primarily known for its role in calcium and phosphorus metabolism and bone health, Vitamin D3 also plays a lesser-understood but emerging role in male reproduction. It is involved in calcium signalling pathways that are crucial for sperm capacitation and acrosome reaction, processes vital for successful fertilization. Additionally, some evidence suggests a link between Vitamin D status and testosterone synthesis.

3.1.5. B Vitamins (Vitamin B Complex): The B-complex vitamins serve as critical cofactors in numerous metabolic pathways, including DNA synthesis and repair (folic acid, B12), energy metabolism (B1, B2, B3), and amino acid metabolism (B6). Folic acid and Vitamin B12 are particularly important for the synthesis of purines and pyrimidines, the building blocks of DNA and RNA, which are essential for the rapid cell division occurring during spermatogenesis. Deficiencies can impair germ cell proliferation and lead to DNA damage in spermatozoa.

3.2. Minerals: Minerals are not merely structural components; they act as crucial cofactors for enzymes involved in metabolism, antioxidant defence, and hormonal regulation, all of which are vital for reproductive success.

3.2.1. Zinc (Zn): This essential trace mineral is a component of over 300 enzymes involved in DNA synthesis, protein metabolism, and cellular differentiation. In male chicken, zinc is critical for normal testicular development, the progression of spermatogenesis, and the biosynthesis of testosterone. It also functions as an antioxidant, being a cofactor for superoxide dismutase (SOD). Studies have consistently shown that zinc supplementation enhances sperm motility, increases sperm concentration, and improves the histological structure of testicular tissue. Its deficiency can lead to testicular hypoplasia and impaired sperm morphology.

3.2.2. Selenium (Se): Selenium is an indispensable trace element integral to the body's antioxidant defence system, primarily as an active component of glutathione peroxidase (GPx), a key enzyme that catalyzes the reduction of hydrogen peroxide and organic hydroperoxides, thereby protecting cell membranes from oxidative damage. Selenium plays a crucial role in safeguarding sperm from oxidative stress and is also involved in sperm maturation and motility. Its synergistic relationship with Vitamin E is well-established, where both nutrients collectively offer enhanced protection against lipid peroxidation in sperm (Fouad *et al.*, 2020).

3.2.3. Manganese (Mn), Copper (Cu), and Iron (Fe): These trace minerals serve as cofactors for various enzymes involved in energy metabolism, antioxidant defence, and steroidogenesis. Manganese is involved in carbohydrate and lipid metabolism and plays a role in the synthesis of steroid hormones. Organic manganese has been shown to improve various aspects of productive performance in broiler breeders, indirectly supporting reproductive function by ensuring optimal metabolic processes (Wang *et al.*, 2019). Copper is a component of superoxide dismutase (SOD) and is essential for normal iron metabolism. Iron, a core component of haemoglobin, is vital for oxygen transport, which is critical for the high metabolic demands of testicular tissue and spermatogenesis. While deficiencies are rare in practical diets, imbalances can negatively impact reproductive health.

3.2.4. Chromium (Cr): Although required in very small amounts, chromium is known to enhance insulin sensitivity and glucose metabolism. While traditionally considered for its role in glucose metabolism, organic chromium supplementation has been linked to improve physiological status and antioxidant enzyme activity in broiler breeders, factors that contribute positively to overall health and potentially reproductive vigour (Wang *et al.*, 2019). Improved metabolic efficiency can indirectly support the high energy demands of spermatogenesis and overall physiological well-being, potentially benefiting reproductive performance (Barber *et al.*, 2023).

3.3. Fatty Acids

Dietary fatty acids, particularly the polyunsaturated fatty acids (PUFAs) are fundamental structural components of sperm cell membranes and play critical roles in their functional integrity.

Omega-3 (n-3) and Omega-6 (n-6) Fatty Acids: The balance and absolute levels of these essential fatty acids are crucial. Sperm plasma membranes are rich in PUFAs, especially docosahexaenoic acid (DHA), an omega-3 fatty acid. These fatty acids influence membrane fluidity, flexibility, and the ability of sperm to undergo necessary changes during capacitation and the acrosome reaction. Supplementation with omega-3 fatty acids, commonly derived from sources like fish oil or flaxseed, has been shown to significantly improve sperm viability, motility, and overall membrane integrity in roosters by enhancing membrane stability and reducing susceptibility to oxidative damage (Fouad *et al.*, 2020; Zhang *et al.*, 2023). An optimal n-6 to n-3 fatty acid ratio is also critical, as an excess of n-6 fatty acids can promote pro-inflammatory responses and increase oxidative stress, which is detrimental to sperm quality. Zhang *et al.* (2023) specifically elucidated that diets enriched with n-3 PUFAs led to increased testicular volume, Sertoli cell number (which support spermatogenesis), and improved sperm motility.

3.4. Antioxidants and Phytogenics

Beyond the traditional vitamins and minerals, a growing body of research is exploring the potential of various natural antioxidants and plant-derived compounds (phytogenics) to enhance male chicken fertility.

3.4.1. Carotenoids (Lutein, Astaxanthin): These naturally occurring pigments found in plants possess potent antioxidant properties. When incorporated in the diet, they can accumulate in reproductive tissues and protect sperm cells from oxidative damage, thereby enhancing sperm viability and functionality.

3.4.2. Polyphenols (Chrysin, Resveratrol, Quercetin): Found abundantly in various fruits, vegetables, and herbs, polyphenols are known for their strong antioxidant, anti-inflammatory, and hormone-modulating properties. For instance, supplementing male broiler breeders with 50 mg of per day enhanced fertility and semen quality, both in fresh and frozen samples(Altawash *et al.*, 2017; Zhandi *et al.*, 2017)..

3.4.3. Herbal Additives (Ginger, Turmeric): Traditional medicine has long utilized these herbs for their purported benefits in reproductive health. Modern research is elucidating that their positive effects on male fertility are often attributable to the presence of various bioactive compounds with antioxidant, anti-inflammatory, and potentially direct spermatogenic effects. Their mechanisms often involve reducing oxidative stress, improving blood flow to reproductive organs, and modulating hormonal balance. Kazemizadeh *et al*. (2019) reported that administering 30 mg of curcumin per rooster per day reduced abnormal sperm, increased the proportion of live sperm, and lowered seminal lipid peroxidation.Studies have shown that curcumin boosts antioxidant status in poultry and enhances testicular function by increasing Leydig and spermatogonia cell counts, seminiferous tubule diameter, and testicular weight (Zhang *et al*.,2015; Kazemizadeh *et al.*, 2018 ; Ruan *et al.*, 2019). Ginger, rich in compounds like gingerol and gingerdione, supports antioxidant defences (Baliga *et al.*, 2011). Supplementing 15 g/kg of ginger root powder improved fertility in aged Cobb males by enhancing sperm quality and antioxidant capacity (Akhlaghi *et al.*, 2014), while 100 µL/kg body weight of ginger essential oil maximized fertility in male quails (Herve *et al*., 2018).

3.5. Amino Acids

Specific amino acids are not only building blocks for proteins but also precursors for critical molecules involved in reproductive physiology.

3.5.1. L-Arginine: This semi-essential amino acid is a precursor for nitric oxide (NO), a crucial signalling molecule involved in vasodilation. Increased NO production can improve blood flow to the testes, ensuring adequate nutrient and oxygen supply for spermatogenesis and steroidogenesis. Arginine also plays a role in protein synthesis and immune function.Supplementing aged cocks with 0.14% L-arginine improved testicular function by increasing testis weight, testosterone levels, and sperm forward motility (Abbaspour *et al.*, 2019).

3.5.2. Carnitine (L-Carnitine): It is essential for the transport of long-chain fatty acids into the mitochondria, where they are oxidized for energy production (Fouad and El-Senousey, 2014). Sperm motility is highly energy-dependent and L-Carnitine supplementation has shown promise in improving sperm energy metabolism, leading to enhanced motility and viability. It also possesses antioxidant properties, protecting sperm from oxidative damage. Dietary supplementation with 125 mg/kg of L-carnitine increased sperm concentration in White Leghorn roosters and improved sperm concentration, viability, and motility in quails (Zhai *et al.*, 2007; Ahangari *et al.*, 2014).

3.5.3. Methionine and Cysteine These sulphur-containing amino acids are precursors for glutathione, a major endogenous antioxidant in the body. By enhancing glutathione synthesis, they contribute to the overall antioxidant capacity, helping to protect sperm from oxidative stress-induced damage. Methionine is also critical for protein synthesis and methylation processes crucial for gene expression.

4. Recent Research and Outcomes

Recent advancements in poultry nutrition research

have provided robust scientific evidence supporting efficacy of targeted nutritional interventions in enhancing male chicken fertility.

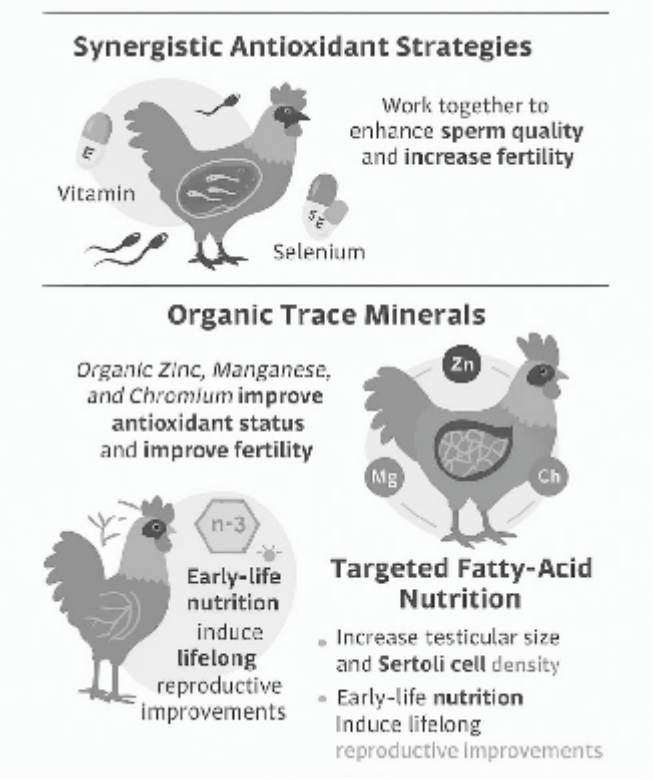

Fig. 3 Recent research outcomes in male chicken nutrition to improve fertility

4.1. Synergistic Antioxidant Strategies: Contemporary research emphasizes the benefits of a combined antioxidant approach rather than relying on single nutrients. Studies, such as that by Fouad *et al.* (2020) demonstrate that simultaneous supplementation with Vitamin E and Selenium significantly improved semen parameters (including sperm concentration, motility, and reduced abnormalities) and overall fertility rates in aging broiler breeders. This highlights the complementary roles of different antioxidants in providing comprehensive protection against multifactorial oxidative stress.

4.2. The Power of Organic Trace Minerals: A significant shift in poultry nutrition has been the adoption of organic forms of trace minerals (e.g., zinc, selenium, manganese). Wang *et al.* (2019) conducted a study demonstrating that replacing inorganic sources of zinc, manganese, and chromium with their organic counterparts in broiler breeder diets significantly improved productive performance, semen quality parameters (e.g., sperm concentration, motility), and enhanced antioxidant status by increasing the activity of key antioxidant enzymes like superoxide dismutase (SOD) and glutathione peroxidase (GPx) in the blood profiles. These findings underscore the superior efficacy of organic trace minerals in mitigating oxidative stress and optimizing physiological functions critical for male reproduction, leading to better overall flock health and fertility outcomes. Barber *et al.* (2023) specifically reported positive effects of organic trace minerals (zinc, manganese, and chromium) on productive performance, semen quality, and antioxidant status in broiler breeder roosters.

4.3. Targeted Fatty Acid Nutritional Programming: The strategic inclusion of specific fatty acids in the diet has yielded significant positive outcomes. Zhang et al. (2023) provided compelling evidence that diets enriched with n-3 polyunsaturated fatty acids (PUFAs) not only increased testicular volume and the number of Sertoli cells (which are crucial for supporting spermatogenesis) but also markedly improved sperm motility and antioxidant status in broiler breeder roosters. Furthermore, the concept of "nutritional programming" is gaining traction. Arscott et al. (2023) demonstrated that early-life dietary interventions, particularly during critical developmental windows, can influence lifelong reproductive traits in male broiler breeders, suggesting that the foundation for robust adult fertility can be laid much earlier through targeted nutrition.

4.4. Impact on Key Sperm Quality Parameters The consistent outcomes observed across these various nutritional interventions include:

- Increased sperm concentration and volume, reflecting enhanced spermatogenic output.
- Improved sperm motility (both total motility and progressive motility), crucial for successful fertilization.
- Enhanced sperm viability and reduced sperm

abnormalities, directly correlating with fertilizing capacity.

- Strengthened sperm membrane integrity, crucial for sperm survival, capacitation, and the acrosome reaction.

- Reduced lipid peroxidation and DNA fragmentation in sperm, direct evidence of reduced oxidative damage, preserving the genetic integrity of the male gamete.

- Ultimately, improved fertilization rates and hatchability, translating into better reproductive performance at the flock level, leading to a higher yield of fertile eggs and viable chicks.

These recent findings underscore the intricate relationship between nutrition and male reproductive success, providing a strong scientific basis for developing more precise and effective dietary strategies in commercial poultry operations.

5. Limitations and Considerations

Despite the promising advancements in nutritional interventions for male chicken fertility, their effective implementation in commercial settings is subject to several practical considerations and inherent limitations that warrant careful attention.

5.1. Strain Variability Genetic lines of male chicken, developed for diverse production traits, can exhibit significant differences in their nutrient requirements, metabolic pathways, and physiological responses to dietary supplementation. A nutritional strategy optimized for one strain may not yield identical results in another, necessitating customized dietary approaches.

5.2. Nutrient Bioavailability and Form The effectiveness of a nutrient is not solely dependent on its inclusion level in the diet but critically on its bioavailability - the proportion that is absorbed and utilized by the bird. For instance, as implied by Barber *et al.* (2023), organic forms of trace minerals are generally more bioavailable than their inorganic counterparts, leading to superior outcomes at lower inclusion rates. Factors like feed processing, presence of anti-nutritional factors, and gut health can also influence bioavailability.

5.3. Excessive Supplementation and Nutrient Interactions: While deficiencies are detrimental, excessive supplementation of certain nutrients can be equally counterproductive, leading to toxicity or creating nutrient imbalances that interfere with the absorption or utilization of other essential elements. For example, high levels of one mineral can antagonize the absorption of another. The synergistic and antagonistic effects between different vitamins, minerals, and other dietary components must be meticulously considered to avoid unintended negative consequences.

5.4. Environmental Factors: Environmental stressors, particularly chronic heat stress, significantly increase the metabolic demands and oxidative burden on male chicken. This can elevate nutrient requirements and modulate the efficacy of nutritional interventions. Similarly, disease challenges or suboptimal housing and managemental conditions can compromise the overall health and reproductive function, limiting the potential benefits of even well-formulated diets.

5.5. Cost-Benefit Analysis: The economic feasibility of incorporating specific, often more expensive, nutritional supplements must be rigorously evaluated. The potential cost of specialized feed additives needs to be weighed against the anticipated improvements in hatchability, chick quality, and overall economic profitability. This requires careful data collection and analysis in commercial settings.

5.6. Integration with Management Practices: It is crucial to recognize that nutrition, while powerful, is only one component of a holistic management strategy. Optimal housing conditions, appropriate lighting programs, effective disease control, precise body weight management, and correct male-to-female breeding ratios are fundamental pillars of successful broiler breeder operations. Nutritional interventions are most effective when integrated into a well-managed system; they cannot fully compensate for deficiencies in other management areas.

Addressing these limitations requires a sophisticated understanding of avian physiology,

careful formulation of diets, and a commitment to integrated management practices to maximize the returns on nutritional investments.

6. Future Perspectives

The field of male chicken reproductive nutrition is dynamic and poised for significant advancements, driven by emerging technologies and a deeper understanding of biological processes.

6.1. Nutrigenomics and Epigenetics: A burgeoning area involves exploring nutrigenomics, which investigates how dietary components interact with the rooster's genome to influence gene expression and, consequently, reproductive traits. Beyond gene expression, epigenetic (the study of heritable changes in gene function that do not involve changes in the DNA sequence) is gaining attention. Research into how early-life nutritional programming (Arscott *et al.*, 2023) can induce epigenetic modifications that impact lifelong reproductive performance offers exciting avenues for long-term fertility improvements.

6.2. Precision Feeding Strategies: Moving away from generalized dietary recommendations, future research will increasingly focus on precision feeding. This involves tailoring diets based on real-time data from individual birds or specific flocks, considering genetic background, age, physiological status (e.g., semen production cycle), phenotypic characteristics, and environmental conditions. Advanced sensor technologies, artificial intelligence, and big data analytics will play crucial roles in implementing such precise nutritional programs.

6.3. Functional Feed Additives (Probiotics, Prebiotics, Synbiotics): The intricate relationship between gut health and overall physiological function, including reproduction, is becoming increasingly clear. Future research will explore the targeted use of probiotics (beneficial live microorganisms), prebiotics (non-digestible compounds that stimulate the growth of beneficial gut bacteria), and synbiotics (combinations of probiotics and prebiotics) to modulate the gut microbiome. A healthy gut microflora can enhance nutrient absorption, reduce systemic inflammation, and potentially influence endocrine functions relevant to reproduction.

6.4. Development of Reproductive Biomarkers: The identification and validation of easily measurable, non-invasive biomarkers for male chicken fertility will be transformative. These biomarkers could provide early diagnostic tools to assess the reproductive status of roosters and the efficacy of nutritional interventions, allowing for timely adjustments to feeding strategies. Examples could include specific metabolites in blood or semen, or gene expression patterns linked to reproductive health.

6.5. Targeted Delivery Systems: For highly sensitive or poorly absorbed nutrients (e.g., certain antioxidants, specific fatty acids), research will focus on developing novel feed additive technologies, such as microencapsulation or nano-delivery systems. These systems can protect nutrients from degradation in the feed or digestive tract and facilitate their more efficient and targeted delivery to reproductive organs.

6.6. Environmental Impact of Nutritional Strategies: As sustainability becomes paramount, future research will also evaluate the environmental footprint (e.g., nutrient excretion, greenhouse gas emissions) of different nutritional strategies. Developing diets that not only enhance fertility but also minimize nutrient waste and environmental pollution will be a key focus.

7. Conclusion

Male chicken fertility stands as an undeniable cornerstone of efficient and profitable poultry production, directly influencing hatchability and overall economic viability. Nutrition, remarkably, emerges as a potent and sustainable strategy for its enhancement. Overwhelming evidence, fortified by recent research, unequivocally supports the indispensable role of a meticulously balanced and strategically formulated diet. Such a diet, replete with essential vitamins (particularly Vitamin E and C), vital minerals (notably selenium and zinc), specific essential fatty acids (especially omega-3s), and promising novel feed additives, demonstrably boasts semen quality, fortifies defences against oxidative stress, and ultimately elevates fertilization rates and subsequent hatchability. The

superior benefits conferred by organic trace minerals and the synergistic efficacy of combined antioxidant strategies have been unequivocally established in contemporary studies. However, the successful translation of these scientific insights into practical, large-scale poultry operations mandates careful consideration of several critical factors. Precise dietary formulation must account for the bioavailability of nutrients, maintain an optimal balance between various dietary components, and be tailored to the specific needs of different genetic strains and environmental conditions.

The future trajectory of male chicken fertility management is bright, with continuous research poised to refine optimal nutrient dosages, explore groundbreaking feed additives, and harness the power of advanced '-omics' technologies for an even more precise and granular understanding of nutrient-reproductive interactions. Integrating these nutritional paradigms with cutting-edge genomics and precision agriculture methodologies holds immense promise for revolutionizing male fertility management in poultry. Therefore, investing in tailored nutritional interventions for male chicken is not merely an operational cost; it is a strategic investment in enduring productivity, resilience, and profitability of the entire poultry breeding sector, crucial for meeting the escalating global demand for poultry products.

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ROLE OF SPECIAL AMINO ACID SUPPLEMENTATION ON PRODUCTION PERFORMANCE OF GOATS

Rahul Singh Chandel*, Yamini Khatri, Ankita Patel, Kuldeep Dudi, Goutam Mondal and Chander Datt

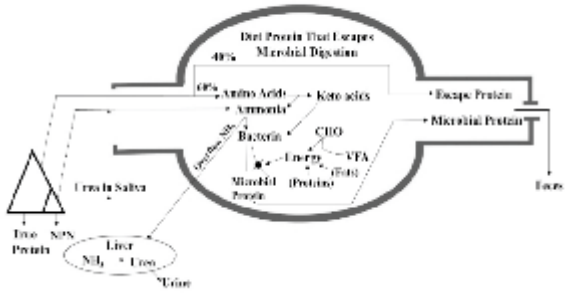
Introduction

Amino acid nutrition is essential for the maintenance of health and productivity. Factors which effects the utilization of amino acids are the efficiency with which the dietary AA is used, the composite of similarity of amino acid composition of absorbed protein and the product to be synthesized, biological value (BV) and efficiency of utilization of ideal protein (Dryden, 2008). Many researchers found that various amino acids, particularly essential amino acids, are lacking when protein levels are decreased. Therefore, supplying essential amino acids is a feasible approach for lowering dietary protein levels (Tuitoek *et al.,* 1997). Goats are an important source of food and economic resource in developed and developing countries and are particularly important in undeveloped countries. Apart from the protein demands of goats, design of a diet formulation for goats should include consideration of the protein level and microbial proteins synthesized in the rumen. Providing a high-protein diet may not improve goat growth but instead may reduce the utilization rate of nitrogen and contribute to environmental pollution (Morse 1995) whereas a lower protein diet reduces nitrogen emission and improves nitrogen utilization.

Pattern of protein/amino acid utilisation in goats

Dietary proteins are digested in gastrointinal tract (GIT) and the resulting amino acids are absorbed into the body and transported to sites of protein synthesis to meet the requirements of the animal. In ruminants, dietary protein is degraded by the rumen microorganisms to ammonia, amino acids and peptides that the microorganisms then use as nitrogen sources to support their own growth (Wu, 2018). Most dietary protein is degraded by the rumen microorganisms and used by them as a source of nitrogen to synthesize their proteins and this microbial protein enters the small intestine and is used by the host (Agricultural Research Council, 1984), but some dietary protein can escape ruminal degradation which is called as bypass protein. It is crucial to reduce the level of CP in ruminant diets with the supplementation of limiting amino acids such as methionine and lysine in order to improve the number of metabolizable amino acids and decrease nitrogen losses, feed costs and greenhouse gas emissions without adverse effect on animal performance (Sinclair, 2014; Guyader *et al.*, 2016).

Protein/Nitrogen utilization in rumen



The primary purpose of the management of amino acid nutrition is to match the profile of amino acids, essential amino acids in particular, in the protein flowing into the small intestine with the amino acid profile of the products. This management is based on an assumption that the body does not need to modify the amino acid profile in MP in de novo protein synthesis because any such modification will lower the efficiency of utilization of dietary amino acids.

Supplementation of limiting amino acids

Amino acid supplementation has shown to improve nutrient utilization, growth performance and survival of the young animal, reproductive performance, wool and hair production and especially increased milk and meat production in ruminant livestock such as cattle, sheep and goats. The most common studies are on Lys, Met, His and Arg supplementation (D'Mello, 2003). Met and Lys generally have no effects on the growth performance (body weight [BW]; body condition score (BCS) and feed intake of dairy cow fed various diets (Blum *et al.*, 1999; Lara *et al.*, 2006; Watanabe *et al.*, 2006; Lee *et al.*, 2015). However, these parameters increased when other AAs such as RP-His, RP-Thr, RP-Leu, RP-ILe were co-supplemented (Lee *et al.*, 2012; Giallongo *et al.*, 2016; Zhao *et al.*, 2019).

Rumen protected amino acids and production performance of goats

Dairy goats

Supplementation of RP-Lys and/or RP-Met and/or RP-His improved milk yield, its composition (protein, fat, lactose, AAs) (Watanabe et al., 2006; Lee *et al.*, 2012; Giallongo *et al.*, 2016; Zhao *et al.*, 2019) in dairy cows, especially when fed a lower protein diet. However, the effects of RPAAs on milk production in sheep and goats are inconsistent. Flores et al. (2009, Titi, 2017) found increased milk production in lactating goats supplemented with RP-Met and in sheep supplemented with RP-Lys plus RP-Met (Goulas *et al.*, 2003; Tsiplakou *et al.*, 2018, 2020). The RPAAs support maternal health and improve the growth and development of young ruminants.

Kids

Third trimester of pregnancy is particularly important for the proliferation of muscle cells and changes in amino acid supply might alter post-natal muscle growth (Greenwood et al., 2000). The RP-Arg increased BW and improved the organ development of goat kids and while improving maternal health profiles (Souri *et al.*, 1998; Zhang *et al.*, 2016; Sun *et al.*, 2018; Wang *et al.*, 2019). Diego *et al.*, 2022 found that methionine inclusion in maternal diet during last third of gestation increased birth weight and BMI and improved the postnatal growth of kids.

Wool/fibre growth

Cystein and methionine are usually considered to be the limiting amino acid for wool production. In Cashmere and Angora goats, Met improved wool growth and fibre production (Souri *et al.*, 1998). For wool and hair production, feeding sulphur-containing AAs such as RP-Met, RP-Bet, or RP-Try increased hair production (growth rate, cashmere length, mohair fibre) in goats (Souri et al., 1998; Ma *et al.*, 2010, 2011). Cystein provides substrate for wool protein synthesis and the synthesis of Cys-rich proteins (Harris *et al.*, 1994).

Conclusions

Supplementation of amino acids especially methionine, cystein and lysine in protected form had positive effects on the productivity and health of goats.

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AQUACULTURE: THE FUTURE OF ANIMAL AGRICULTURE IN INDIA

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Introduction

The fisheries and aquaculture sector in India is undergoing a significant transformation, driven by modern technologies, strategic investments, and progressive policy interventions. India's fish production has witnessed a remarkable increase, surging from merely 0.75 million tonnes in 1950 to 18.4 million tonnes in 2023-24 reflecting nearly a 24-fold growth. The fisheries sector now contributes approximately 1.1% to the national Gross Domestic Product (GDP) and accounts for 6–7% of the agricultural GDP. Export earnings from fisheries have also shown significant growth, doubling over the past decade to exceed ₹ 60,000 crore. The consistent increases in government investment, through schemes such as PMMSY, continue to drive the expansion and modernization of fisheries sector. As a major contributor to the economy, employment, and nutrition security, the sector has evolved from traditional capture fisheries to a more diversified and technology-intensive enterprise. The Indian fisheries sector plays a critical role in the socio-economic fabric of the country. It currently supports the livelihoods of over 28 million fishers and fish farmers. As India aspires to become a global leader in animal-based protein production, aquaculture presents a viable and environmentally sustainable route for addressing the protein gap, improving rural livelihoods, and contributing to national economic development.

Aquaculture Potential

Over the past few decades, aquaculture has emerged as the fastest-growing food production sector globally. India is the second-largest producer of aquaculture products in the world. India's aquaculture sector primarily consists of freshwater aquaculture (contributing around 85% of total production) and a smaller but growing marine and brackishwater component. Key species in Indian aquaculture include Indian major carps (e.g., rohu, catla, mrigal), pangasius, tilapia, and shrimps (especially *Penaeus vannamei*). India with its 11098 km long coastline, extensive EEZ, and suitable climatic zones, holds an estimated mariculture potential of 4–8 million tonnes annually. However, current production remains significantly below capacity. India stands at a critical juncture in its fisheries development journey. The convergence of innovative technologies, policy reforms, and public investments is paving the way for a sustainable blue revolution. As the country seeks to double farmers' income, boost exports, and meet growing nutritional demand, aquaculture and mariculture will be central to realizing these goals. According to the FAO's State of World Fisheries and Aquaculture 2024, global mariculture production reached approximately 35.7 million tonnes of food fish in 2022, accounting for nearly 28% of the world's total food fish aquaculture output. When including seaweed and other aquatic plants, total mariculture production rose to around 75.4 million tonnes, representing about 57% of global aquaculture production. In India, mariculture holds immense promise, driven by a rapidly increasing demand for seafood and the extensive coastal resources of the country, which remain largely underutilized for marine farming activities. India's mariculture sector, though still nascent, holds immense potential with an estimated production capacity of 4–8 million tonnes annually. Currently, sea cage farming and seaweed cultivation are expanding, with Tamil Nadu and Gujarat leading initiatives. Several mariculture activities are being promoted, particularly in Tamil Nadu, Gujarat, Maharashtra, and the Andaman and Nicobar Islands.

Current practices fuelling Aquaculture in India

Sea cage farming allows high-value species like cobia, seabass, and groupers to be farmed in offshore waters. Initiated by ICAR research institute CMFRI, sea cage farming has gained momentum particularly along the coasts of Tamil Nadu, Kerala, Andhra Pradesh, and Goa. The technology offers a viable alternative to capture fisheries, helping to meet seafood demand while providing livelihood opportunities for coastal communities.

Seaweed farming, especially in the Gulf of Mannar and Gulf of Kutch, is scaling up with targeted investments and projected to reach 100,000 tonnes per year by 2025. It involves the cultivation of fast-growing marine macroalgae like Kappaphycus alvarezii, Gracilaria, and Ulva along coastal regions, particularly in Tamil Nadu, Gujarat, Maharashtra, and the Andaman & Nicobar Islands. Seaweed farming requires minimal inputs, does not need freshwater or fertilizers, and helps improve marine biodiversity while absorbing excess nutrients and carbon dioxide. The harvested seaweed is used in pharmaceuticals, food, cosmetics, biofertilizers, and biofuels.

Integrated Multi-Trophic Aquaculture (IMTA) is a promising and environmentally sustainable approach that involves the co-culture of species from different trophic levels within the same system. IMTA combines fed species like fish (e.g., seabass), extractive species like shellfish (e.g., mussels), and nutrient-absorbing organisms like seaweeds. IMTA minimizes nutrient waste and mitigates eutrophication risks in coastal waters. Coastal states like Kerala, Tamil Nadu, and Gujarat are exploring IMTA models using cobia, oysters, and Gracilaria seaweed.

One of the most promising developments in Indian fisheries and aquaculture sector is the adoption of advanced aquaculture technologies. Technological advancements have also contributed significantly to the transformation of Aquaculture sector in India. The adoption of biofloc technology (BFT), recirculating aquaculture systems (RAS), and precision aquaculture using IoT, AI, and digital monitoring tools is improving water quality management, disease control, and feed efficiency. Genetic improvement programs and sustainable feed innovations are further ensuring

Recirculatory Aquaculture Systems (RAS): These systems facilitate high-density fish farming in controlled environments with minimal water usage. RAS units recycle and purify water, reducing dependence on natural water bodies and ensuring year-round production. In India, RAS is gaining momentum as a viable alternative to traditional aquaculture, particularly in regions with limited water and land resources. It is increasingly used for rearing high-value species such as Asian seabass, tilapia, pangasius, and ornamental fish. Supported by government initiatives like the Pradhan Mantri Matsya Sampada Yojana (PMMSY), several entrepreneurs and farmers are adopting RAS for commercial farming and hatchery operations.

Biofloc Technology (BFT) is an advanced aquaculture system that promotes sustainable fish and shrimp farming by converting organic waste into useful microbial biomass, which can be consumed by cultured species as a supplementary protein source. It reduces water exchange, enhances water quality, and lowers feed costs, making it an eco-friendly and cost-effective solution for intensive aquaculture. BFT is a cost-effective solution for water treatment and nutrient recycling and it enables high productivity even in limited spaces. It also reduces feed costs by utilizing microbial flocs as supplemental feed.

Genetic Improvement and Selective Breeding: This is an essential tool in modern aquaculture which is aimed at enhancing desirable traits such as growth rate, disease resistance, feed efficiency, stress tolerance, and reproductive performance in cultured species. By applying principles of quantitative genetics, aquaculture scientists selectively breed individuals with superior traits over successive generations, leading to genetically improved strains that significantly boost productivity and profitability in aquaculture. In India, genetic improvement programs have been initiated for several species, including *Labeo rohita (rohu), Catla catla, Penaeus indicus, Penaeus monodon and Macrobrachium rosenbergii*. The success of genetically improved rohu (e.g., Jayanti rohu developed by CIFA, Bhubaneswar) has demonstrated the potential of selective breeding to

enhance growth performance by over 30%.

Conclusion

Indian aquaculture sector has witnessed significant growth over the past decades, evolving from traditional practices to the adoption of advanced technologies such as Biofloc, RAS, sea cage farming, selective breeding and genetic improvement program. The way forward involves a collaborative approach that bridges gaps between research, policy, and practice. As the nation moves towards achieving a sustainable blue economy, aquaculture must be seen not just as a fish-producing activity but as a vital contributor to the broader goals of food security, rural development, and environmental sustainability.

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FISH IN ANIMAL AGRICULTURE: NORTHEAST INDIA'S WAY FORWARD

Chandan Debnath

Animal agriculture in India

India's animal agriculture sector is at a pivotal point, where meeting the protein demands of a growing population must align with sustainable development goals. Contributing 11.9% to global agricultural production value, this sector forms the backbone of rural livelihoods for millions of farming families. It includes diverse enterprises such as dairy farming, poultry, goat and pig rearing, and aquaculture—each playing a vital role in advancing the nation's food security and nutritional needs. As India moves toward developed nation status by 2047, the strategic advancement of animal agriculture is essential for ensuring protein security, rural employment, and export competitiveness. Beyond food production, the sector also drives employment, generates foreign exchange, and supports ancillary industries, collectively strengthening India's agricultural economy.

In India's agricultural framework, animals serve as "living banks" and cash-generating assets, offering farmers immediate liquidity and steady income—unlike seasonal crop enterprises. This makes animal agriculture especially vital for small and marginal farmers, who represent 86.2% of the agricultural workforce and depend on consistent earnings year-round. The biological capacity of animals to multiply generates compounding returns on investment, while their role as a buffer against crop failure and economic shocks enhances rural resilience. As India advances its agricultural transformation agenda, unlocking the full potential of animal agriculture across all regions is critical for doubling farmers' income and achieving sustainable rural development. Integrating modern technologies with traditional knowledge provides a scalable path forward, enabling growth while preserving India's cultural heritage and ecological diversity.

Northeast India's potential

Northeast India represents one of India's most underutilized regions for animal agriculture development, possessing unique advantages that can significantly contribute to the nation's protein security and economic growth objectives. The eight states of Northeast India—Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura—collectively harbor exceptional biodiversity and natural resources that position the region as a strategic asset for India's animal agriculture expansion. What sets Northeast India apart in the national context is the population's daily dietary requirement for fish, unlike other animal proteins such as chicken, pork, or beef which are consumed occasionally, creating a consistent and reliable market demand that ensures economic viability of aquaculture enterprises. With over 75% area under forest cover, the region provides natural ecosystem services and habitat diversity that support sustainable animal production systems while maintaining ecological balance.

The Northeast region's strategic location at the intersection of the Indo-Malayan and Palearctic biogeographical realms presents unique opportunities to develop specialized animal agriculture enterprises catering to both domestic and international markets. The region's demographic dividend—marked by a young, trainable population—offers a strong foundation for modernizing the sector through skill development and technological integration. However, several districts are highly vulnerable to

climate change, as identified by the Department of Science & Technology, Government of India, underscoring the need for climate-resilient approaches in animal agriculture. Targeted policy initiatives such as the North East Industrial Development Scheme (2017) and the Act East Policy (1991) provide enabling conditions for incorporating the region into India's broader animal agriculture strategy. Such integration is vital for promoting balanced regional development while leveraging the Northeast's comparative advantages in sustainable livestock production.

Fish: The key component

In the context of India's animal agriculture transformation, fish from Northeast India emerges as a strategic component that can significantly contribute to the nation's protein security while demonstrating sustainable production models for other regions. With more than 90% of the population consuming fish regularly, Northeast India represents India's most fish-dependent region, where aquaculture has evolved as both a cultural practice and economic enterprise. The states of Tripura, Assam, and Manipur ranking among India's highest per capita fish consuming states demonstrates the region's potential for scaling up production to meet both local and national demand. This consumption pattern aligns with global trends where aquaculture has become the fastest-growing food production sector, reaching 66.6 million metric tons valued at US$137.7 billion, indicating the sector's potential for contributing to India's economic growth. The engagement of over 26 lakh people in Northeast India's fisheries sector illustrates the employment generation potential that can be replicated across other regions of India.

Northeast India's status as a fish biodiversity hotspot, housing over 400 fish species including numerous endemic varieties, provides India with unique genetic resources for developing high-value aquaculture products for domestic and export markets. Indigenous species such as Golden Mahseer, various Tor species, and endemic cold-water fishes command premium prices and represent opportunities for niche market development that can enhance India's competitiveness in global seafood trade. The cultural integration of fisheries within tribal and matrilineal societies demonstrates sustainable community-based models that align with India's emphasis on participatory development and social inclusion. For forest dwellers who constitute a significant portion of the region's population, fish provide essential ecosystem services including water quality maintenance, nutrient cycling, and biodiversity conservation, offering models for sustainable animal agriculture that other regions can adopt. This integration of production with conservation demonstrates how India can achieve its environmental commitments while meeting protein security goals.

Current status and market dynamics

Northeast India's fisheries sector currently operates with traditional practices and emerging commercial potential that positions it strategically within India's national animal agriculture value chains. The region's consumption patterns, showing demand for both fresh and processed fish products, create market opportunities that can be integrated with India's growing aquaculture industry and export ambitions. Traditional fishing practices have maintained fish populations sustainably for generations, providing proven models for sustainable aquaculture that align with India's commitments to environmental conservation and climate action. The diversity of aquatic ecosystems, from major river systems to hill streams, supports production systems that can supply different market segments and contribute to India's goal of becoming a major seafood exporter. Fish farming operates across multiple scales, from household nutrition systems to commercial ventures, demonstrating scalable models that can be adapted to different regions across India.

The cash-generating potential of fish farming in Northeast India provides evidence for animal agriculture's role in rural economic development and farmer income enhancement across India. Unlike seasonal crop agriculture, fish farming generates income through multiple harvesting cycles and year-round sales, providing stability that supports India's objective of doubling farmers' income. The biological efficiency of fish as protein converters makes aquaculture an economically viable enterprise that can contribute to India's protein security while requiring minimal land and

water resources compared to other animal agriculture sectors. The consistent local market demand and consumer preferences create a foundation for scaling up production to serve regional and national markets. The region's strategic location offers potential for enhancing India's cross-border trade in fish and fishery products, particularly with Southeast Asian countries, contributing to India's Act East Policy objectives and export growth targets.

Challenges

Northeast India faces significant climate change vulnerabilities that pose challenges to the development of its fisheries and animal agriculture sectors. According to assessments by the Department of Science and Technology, Government of India, several districts across the region are highly susceptible to climate-induced risks, necessitating region-specific, climate-resilient strategies. In Arunachal Pradesh, the most vulnerable districts include Lower Subansiri, Tawang, West Siang, East Siang, Lohit, and Dibang Valley. In Assam, districts such as Kokrajhar, Dhubri, Barpeta, Morigaon, Dhemaji, Baksa, Darrang, Dibrugarh, Goalpara, Golaghat, Sivasagar, Sonitpur, and Tinsukia have been identified as particularly at risk. Mizoram's Hnahthial district has recorded the highest vulnerability score in the region. In Tripura, while several districts show high vulnerability, the variation across the state is relatively low, indicating a uniformly vulnerable landscape. Nagaland presents a contrasting pattern with significant variability between its most and least vulnerable districts, highlighting the need for localized interventions. Sikkim, on the other hand, exhibits relatively uniform and moderate vulnerability levels across its districts. These patterns underscore the urgent need for integrated climate-resilient infrastructure and policy frameworks tailored to the unique geographical and ecological profiles of each state within the Northeast.

Northeast India's porous borders allow widespread intrusion of exotic fish species, threatening native fauna and increasing the risk of transboundary diseases. Frequent extreme weather events add to production risks, requiring integration with national insurance and risk management systems. Cold climates in hill states hinder traditional fish species like catla, rohu, and mrigal, highlighting the need for cold-tolerant varieties and greenhouse-based aquaculture—necessitating national research and technology support. Environmental degradation and habitat loss call for policies aligning fisheries with biodiversity and forest conservation goals. Fragmented production systems require institutional support for aggregation, market linkage, and integration with national value chains. Lastly, the shortage of trained professionals underscores the need for region-specific capacity building through national skill development and education programs.

Opportunities

The development of Northeast India's fisheries sector presents strategic opportunities that align with multiple national priorities and can serve as a model for sustainable animal agriculture development across India. The region's fish biodiversity hotspot status provides India with unique genetic resources for developing high-value aquaculture products that can compete in global markets and contribute to export growth targets. The potential for developing specialized aquaculture of indigenous species offers opportunities for creating geographic indication products and premium brands that enhance India's position in global seafood markets. Technological advances in aquaculture can be piloted in the region and subsequently scaled across India, contributing to the nation's technology leadership in sustainable fish production. The integration of traditional knowledge with modern technology offers models for sustainable development that align with India's emphasis on innovation-led growth and cultural preservation.

Government initiatives for Northeast development create opportunities for integrating the region into national animal agriculture value chains and export infrastructure. The region's young demographic profile provides human resources that can be developed through national skill development programs to serve both regional and national animal agriculture sectors. The growing consumer preference for organic and natural food products aligns with the region's potential for eco-friendly aquaculture systems that can command premium

prices in health-conscious markets across India. Digital technology adoption can connect Northeast producers directly with national and international markets, contributing to India's digital agriculture transformation. The development of climate-resilient production systems in the region can provide models for adaptation strategies that other climate-vulnerable regions across India can adopt.

Way forward

Realizing Northeast India's contribution to India's animal agriculture vision requires a comprehensive national strategy that integrates regional development with sector-wide transformation objectives. Establishing Centers of Excellence for indigenous fish breeding and aquaculture technology in the region will create knowledge hubs that serve national research and development needs while preserving genetic diversity. Investment in climate-resilient infrastructure, including cold storage networks, processing facilities, and transportation systems, should be integrated with India's national infrastructure programs to ensure regional connectivity with national and international markets. Development of integrated farming systems that combine aquaculture with agriculture and livestock will create replicable models for sustainable animal agriculture that can be scaled across different agro-ecological regions of India.

Strengthening disease surveillance and control mechanisms through national laboratory networks and para-veterinary training programs will protect investments while building resilience across India's aquaculture sector. Human resource development through specialized institutions and skill development programs should be linked with national employment generation schemes to create career pathways in animal agriculture across India. Access to institutional credit and innovative financing mechanisms, including crop insurance and climate risk instruments, should be extended to support both regional development and national sector growth. Climate-smart aquaculture practices developed in the region should be integrated with India's climate action programs and disseminated to other regions facing similar challenges.

Establishing market linkages through producer organizations and value chain integration will connect regional production with national and international markets while building collective capacity for quality and safety compliance. Creating value addition infrastructure and quality certification systems will enable participation in premium markets while contributing to India's food safety and export quality standards. Early warning systems for climate risks should be integrated with national disaster management and agricultural risk monitoring systems. Policy frameworks should align regional development with national animal agriculture policies while addressing specific geographical and cultural contexts.

Development of community-based management systems that integrate production with conservation will create models for sustainable development that support India's environmental commitments while achieving economic objectives. Finally, establishing monitoring and evaluation systems that track progress toward national goals will ensure accountability and adaptive management for achieving India's animal agriculture vision through regional contributions.

Conclusion: Northeast India's role in India's animal agriculture future

Northeast India's fisheries sector represents a strategic asset for achieving India's animal agriculture transformation goals while demonstrating sustainable development models that integrate economic growth with environmental conservation and cultural preservation. The region's potential to contribute to India's protein security, employment generation, and export competitiveness positions it as a critical component of the national animal agriculture strategy. With over 90% fish consumption, biodiversity hotspot status, extensive forest cover, and over 26 lakh people engaged in fisheries, the region provides both the foundation and the imperative for strategic development that serves national objectives.

The cultural acceptance of fisheries, presence of high-value indigenous species, and ecosystem services for forest communities create unique advantages that can be leveraged for developing innovative models of sustainable animal agriculture. However, realizing this potential

requires coordinated national action that addresses infrastructure deficits, climate vulnerabilities, technology gaps, and market access limitations through integrated policy interventions. The way forward demands an approach that positions Northeast India not as a peripheral region but as a strategic contributor to India's animal agriculture vision, requiring investments, institutions, and innovations that connect regional advantages with national and global opportunities.

Success in developing Northeast India's fisheries sector will demonstrate India's capacity to achieve inclusive growth that harnesses regional diversity for national strength while maintaining ecological sustainability and cultural authenticity. This transformation will establish fish as important cash crops that provide immediate income and long-term asset accumulation while preserving the cultural significance of fish in regional communities and the ecosystem services that forest dwellers depend upon. Ultimately, Northeast India's fisheries development will serve as a model for how India can achieve its animal agriculture vision through strategies that combine economic growth with social inclusion and environmental stewardship, contributing to the nation's journey toward becoming a developed economy by 2047.

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SHEEP FARMING: A PROFITABLE PROPOSITION

Jui Lodh, D C Sen, Tanmay Hazra and Rashmi Kumari

Introduction

The domestication of livestock, marked a pivotal shift during the Neolithic period when human societies transitioned from a hunter-gatherer existence to agriculture and settled life. Initially, animals were domesticated primarily for agricultural support with sheep being the earliest. For millennia, sheep and goats, served as essential sources of sustenance (meat, milk) and clothing (wool). This period is believed to be the genesis of utilizing sheep milk as a food source which subsequently became a valuable source of nutrients. In rural India, small ruminants like sheep and goats, play a crucial socio-economic and cultural role, providing livelihoods for a significant portion of the rural populace. According to the 20th Livestock Census (2019), the share of the country's livestock population comprises approximately, cattle (36.04%), goats (27.74%), buffaloes (20.74%), and sheep (13.83%). Small sheep farming a vital source of livelihood in many countries of the world. Small ruminants are particularly advantageous for small landholders and village-based livestock systems due to low startup costs, easy handling and efficient feed conversion. They are also resilient to extreme climates, migrations, diseases, water, etc. Sheep are a multifaceted asset in the Indian agrarian economy, providing meat, wool, skin, manure and milk. They are ideal for dryland areas, efficiently utilizing limited vegetation resources. As per Food and Agriculture Organization Corporate Statistical Database (FAOSTAT, 2019), India ranks second in sheep population after Mainland China (163.48 million heads) accounts for more than 4.03% of the world population with 74.26 million heads. Telangana holds first rank in sheep population (25.72%) followed by Andhra Pradesh (23.70%) and Karnataka (14.95%). However, sheep breeds available in India are mainly low milk producers.

The share of global milk production constitutes by cows (85%) followed by buffalos (11%), goats (2.3%), sheep (1.4%) and camel (0.2%), respectively. Asia leads in sheep milk production, contributing 45.6% of the global output. China and Turkey are the foremost producers in the Asia while Greece stands with a remarkable share of the total sheep milk production in Europe. Other notable sheep milk producer countries are Syria, Romania, Spain, Italy, France, Algeria, etc. Product attributes, high yield, higher nutritional value with wide health benefits are the factors which boost up the market size of sheep milk and its byproducts throughout the world. Sheep milk is highly valued for the production of cultured dairy products, especially cheeses and yogurt. This is largely attributed to its high content of protein, fat and calcium, making it an excellent base for cheese production. In addition, sheep milk is nutritionally better than milk from many other domesticated animals. Today, sheep milk is also considered a delicacy in many countries. Other important sheep milk products are butter and ghee. Total cheese production from sheep milk in the world is nearly 680.30 million kg while butter and ghee is 63.25 million kg. In India, sheep are mainly used for the production of wool and mutton.

Sheep breed

There are almost 60 sheep breeds present in India. Among these, till date, the National Bureau of Animal Genetic Resources (NBAGR, 2021), Karnal has registered the details of 44 distinguished sheep breeds. NBAGR (2021) categorizes Indian sheep breeds based on their agro-ecological regions namely a) North temperate region, b) North

Western arid and semi-arid region, c) Southern peninsular region and d) Eastern region. However, a substantial portion of the Indian sheep population remains uncategorized due to extensive interbreeding and lack of documented origins, known as "non-descript" category. The Nellore breed holds the largest share accounting for 19.17% of the population. Other breeds contributing significantly include Deccani, Marwari, Bellary, Jaisalmeri, Mecheri, etc. Most sheep breeds in India are primarily used for either meat or wool production. However, many are dual-purpose breeds valuable for farmers, aim to produce both commodities. Patanwadi and Panchali are raised for mutton and milk production.

Sheep milk

Sheep milk is highly regarded for its nutritional value and potential health benefits. It boasts a high content of calories, fat, protein, essential vitamins and minerals compared to cow milk. Like goat milk, it is naturally homogenized, making it easier for the use of new born and elder persons. The composition of sheep milk is influenced by various factors like breed, individuals, season, diet, feeding management, climatic conditions, stage of lactation, health of animals, etc. the average composition of milk from various dairy animals has been highlighted in Table 1. Sheep milk is characterized by its white colour, due to the absence of the yellow pigment carotene. It possesses a rich and creamy texture with a distinct flavour. Compared to cow milk, sheep milk contains high total solids, fat, protein and solids-not-fat. It is also a rich source of minerals (calcium, phosphate, and magnesium) and vitamins (A, D, E, K). Moreover, sheep produce less milk than cows but sheep milk contains significantly higher amount of fat, nearly double that of cow milk. Sheep milk is abundant in short and medium-chain fatty acids (SCFAs and MCFAs), unsaturated fatty acids, and conjugated linoleic acid (CLA); all of which are beneficial to our health. Sheep milk also has a higher caloric value, providing 111 Kcal/100 ml than cow milk (71 Kcal/100 ml). The higher proportion of fat, solids-not-fat (SNF) and protein contributes to its greater viscosity, making it an ideal raw material for the production of yogurt. The dense network of proteins and the resulting firmness of the milk gel in sheep milk contribute to its suitability for production of several types of cheeses. It is also reported that sheep milk yields the highest amount of cheese and curd per volume compared to milk from other ruminants.

Table: 1 Average composition of milk from different dairy animals

Constituents (%)	Sheep	Goat	Cow	Buffalo
Water	80.71	87.00	86.61	82.76
Total Solids	19.29	13.00	13.19	17.24
Fat	7.90	4.25	4.14	7.38
SNF	11.39	7.75	9.25	9.86
Protein	5.23	3.52	3.58	3.60
Lactose	4.81	4.27	4.96	5.48
Ash	0.90	0.86	0.71	0.78
Energy (Kcal/100ml)	111	69	71	102

Source: Kapadiya et. al., 2016; Giambra et. al., 2014; Thompkinson and Sabikhi, 2012)

Health benefits of sheep milk

Sheep milk is very nutritious as compared to the other three dairy animals (Table 1). The higher protein, fat, vitamins and minerals, combined with bioactive components, make it valuable for supporting digestive health, bone strength, cardiovascular function and immune resilience. Some of the health benefits associated with sheep milk are given here.

1. Higher nutritional density: Sheep milk has higher levels of fat, protein, vitamins and minerals than cow milk. It is an excellent source of protein because it contains all nine essential amino acids which are needed for the growth and repair of our body. Sheep milk is also rich in vitamins like A, D, various B-vitamins and minerals like calcium, phosphorus and zinc.

1. Enhanced digestibility: Due to the smaller size of fat globules and higher levels of short- and medium-chain fatty acids, sheep milk is often considered easier to digest than cow milk. Its casein content is less likely to trigger allergic responses and gastrointestinal issues, making it a better option for those who suffer from milk allergy and digestibility problem.

2. Boosts immune function: The bioactive compounds and immunoglobulins present in sheep milk help in enhancing our body immune defenses. Presence of zinc and selenium, contribute to antioxidant activity and support immune cell functions. High vitamin A and E contents also aid

in maintaining the integrity of epithelial tissues and immune responses.

3. Bone health support: Due to its high calcium and phosphorus contents, sheep milk is beneficial for bone growth and density. Regular consumption of sheep milk may help in preventing osteoporosis, especially for elderly people.

4. Cardiovascular benefits: Sheep milk contains bioactive peptides which can exert antihypertensive effects by inhibiting angiotensin-converting enzyme (ACE), thereby help in regulating blood pressure. The presence of CLA, known for its anti-inflammatory and lipid-lowering effects, may further support in heart health.

5. Cognitive and neurological benefits: The presence of B vitamins, especially vitamin B_{12}, along with essential fatty acids, support brain health and neurological functions. Regular intake may contribute to improve memory, concentration and mood regulation.

6. Potential for wound healing: Hydrogel dressings infused with sheep milk bioactive substances, like proline and lactoferrin, have shown promising effect in accelerating wound healing. Components of sheep milk support in collagen synthesis and reduce inflammation.

Sheep milk products

Sheep milk is a versatile dairy product that can be transformed into a wide range of products. The rich composition of sheep milk, makes it suitable for production of various dairy products like cheese, yogurt, ghee, butter, ice-cream, kulfi, paneer, etc.

Cheeses: It is extensively used for cheese production. Feta, Roquefort, Manchego, Ricotta, Romano, etc. are some well-known cheeses developed from sheep milk in different countries. Sheep milk cheese is highly prized, not only for its delicious taste but also for its appealing appearance, texture, and nutritive qualities. Italy (36%) and France (20%) are the top exporters of sheep milk cheese.

Yoghurt and other fermented products: Sheep milk yogurt is highly prized for its dense protein network and firm gel texture. Kefir, another fermented milk product, can also be made from sheep milk.

Butter and ghee: Sheep milk is also used to produce butter and ghee, particularly in some regions of Asia and Africa. It is rich in essential fatty acids, CLA and vitamins A, D, E, K. It has a high smoke point and can be used for cooking at high temperatures.

Other sheep milk products: High total solids content of sheep milk make it suitable for producing ice cream without incorporating additional fat or protein. Sheep milk is bottled for direct consumption in some countries like United Kingdom. The whey obtained from cheese production can be further processed into whey protein concentrate. Milk powder with long shelf life can be produced from sheep milk. In addition, sheep milk is also used for manufacture of skincare product formulations like soap, cream, lotion, etc.

Products other than milk:

Meat: The demand for mutton, particularly in the southern states and other parts of India, is experiencing a rapid increase. In southern regions, 70% of total sheep mostly utilized for meat production. This escalating demand presents both opportunities and challenges for the sheep farming sector in India. The increasing demand for mutton and the current production systems, which heavily rely on natural resources, are proving insufficient to meet the rising demands. To bridge this gap and accelerate mutton production, adoption of modern technology and management practices are crucial.

Wool: Sheep wool is a valuable natural fiber with several properties that make it suitable for various applications. In India, sheep wool plays a significant role in the rural economy and is used for manufacturing a range of products based on the quality of wool. India ranks 9th and accounts nearly 2% of global wool production. The wool productivity is 0.9 kg/sheep/year. 15% of sheep found in Rajasthan, Gujarat and Uttar Pradesh are producing carpet type wool and meat while 6% of sheep found in Jammu & Kashmir, Himachal Pradesh and Uttrakhand are producing fine wool and meat.

Nutrition for sheep

In many regions, especially among smallholders and in areas with limited resources, small ruminants such as sheep and goats are primarily sustained through extensive grazing but with low productivity, high morbidity and mortality. Adequate nutrition is crucial to maintain health, achieve optimal growth, maximize production (meat, milk, and wool), and ensure successful reproduction throughout the year. The specific requirements for energy, protein, minerals, and vitamins depend on sheep physiological stage and environmental conditions.

(a) Nutrition for wool production:

Wool is primarily composed of protein, contains more than 20 amino acids along with smaller amounts of other substances like fat, sodium and calcium. Nutrition plays a vital role in both quantity and quality of wool production. Energy is the most significant and limiting factor in sheep diet which has high impact in wool production. A deficiency in energy can lead to reduction in wool fibre diameter, slower wool growth and frail spots in wool. To produce approximately 453.6 g of wool, sheep require a substantial amount of quality feed, ranging from 11.3 to 13.6 kg/animal. For grazing sheep, a daily intake of 800-1500 g of dry matter is generally considered adequate for optimal wool production. Amino acids like cysteine and methionine, are crucial for wool production. Common protein supplements used like deoiled cakes and meals such as soybean meal, groundnut cake, mustard cake, sesame cake, cottonseed meal, sunflower meal, etc. Minerals are vital for wool production like calcium, manganese, iron, sodium, potassium, sulfur, phosphorus, magnesium, cobalt, iodine, selenium, copper, zinc, etc. Studies indicate that copper, zinc, iodine and possibly selenium, are directly involved in wool growth and follicle functions. Vitamins are also important for wool production. However, a balanced diet with appropriate supplementation can improve healthy wool growth and contribute to the overall wellness of the flock.

(b) Nutrition for meat production:

Effective nutritional management is important for achieving desirable meat production.

Pre weaning and post weaning: The pre-weaning period is critical for adequate lamb development. In sheep rearing, maximum income generates during post weaning period where lambs are sold for mutton. Generally, lambs are sold for meat at 3-4 months, reaching 12-14 kg slaughter weight. Medium-sized breeds usually reach a mature weight of 30 kg at 12 months which can be achieved in 135 to 150 days of age with intensive feeding systems. Lambs are entirely stall-fed on a complete ration, typically a 50:50 or 60:40 ratio of concentrate mixture to roughage to reach 30-33 kg body weight by six months.

Conclusion

Since ages, sheep have been serving as a crucial source of livelihood for the rural people throughout the world. Their adaptability makes them well suited for utilizing sparse vegetation in dryland environment management. Sheep milk is highly nutritious, boasting a rich composition of proteins, fats, minerals and vitamins compared to the milk of cow, buffalo and goat. World-renowned cheeses, yogurt, ghee, butter, ice cream, etc. are produced from sheep milk. Sheep are a primary source of high-quality meat (mutton) and wool, both of which are in high demand globally. The sale of these products provide a dependable income for farmers. Sheep also provide hides, skins and manure which further contribute to the farmer's income. Sheep farming offers significant potential for entrepreneurship development, particularly for small landholders in rural areas. Sheep are relatively easy to manage, require less labour than other livestock, and have lower housing costs. Their high reproductive rate allows for quick flock expansion. They are also efficient converters of various plants, including low-quality forage and crop residues, into meat and wool. Sheep farming while offers many advantages, it also faces challenges. These can be addressed through strategic interventions including genetic improvement, scientific rearing practices, reproductive management, health management, nutrition, etc. By addressing these challenges through effective strategies and leveraging the inherent advantages of sheep farming, the sector can continue to serve as a vital source of livelihood and contribute significantly to the economy, particularly in regions with limited resources. In

view of this, perhaps it will not be inappropriate if it is said that effective sheep farming has a scope to double the farmer income.

Fig. 1 Sheep Farming

(a) Soft Sheep Milk Cheese **(b) Hard Sheep Milk Cheese** **(c) Yoghurt**

Fig. 2 Sheep Milk Products

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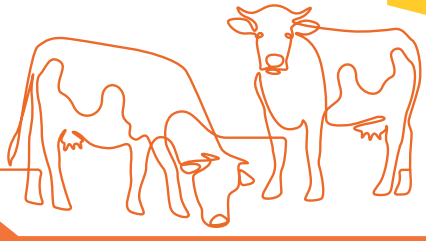

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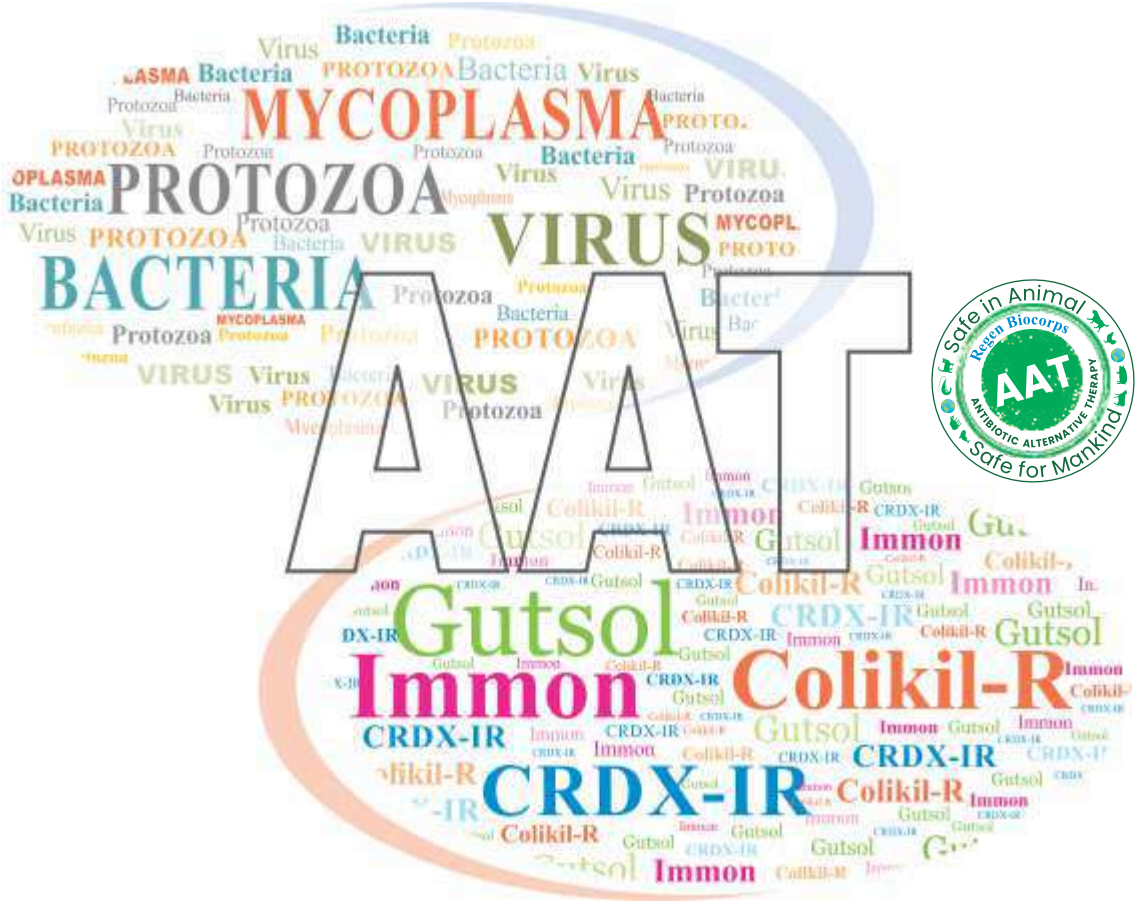

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