55th Annual General Meeting (AGM) & 63rd National Symposium 2022

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30th September & 01st October 2022

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We feel proud that India contributes to 23% of global milk production and is a leading milk producer. In terms of employment, dairy sector is the direct income providing sector to more than 8 crore farmers. However, the production potential of our bovine herd remains largely untapped, which necessitates a relook into the present livestock production dynamics. We need our animal agriculture system productive, sustainable, futuristic and welfare oriented Changing dynamics should focus on cost effective feeding and sustainable feed market. In this context, theme of Symposium “Changing Dynamic of Animal Agriculture in India is quite relevant. I hope recommendations of the Symposium will contribute to a harmonized livestock system in the country.

On the occasion, I extend my heartiest congratulation to the organizers of the Symposium and wish it a grand success.

(Parsghottam Rupala)
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MESSAGE

I am delighted to learn that CLFMA of India, set up in 1967, as the Compound Feed Manufacturers Association, is organising the 63rd National Symposium on `Changing Dynamics of Animal Agriculture in India`. The association is the apex organization for the Livestock Industry.

The Livestock sector is the backbone of India’s rural economy. It is noteworthy that over 60% of rural households have livestock as part of their economic activity and livelihood. Livestock sector is a source or reliable income and a source of upward economic mobility for the poorest, while also being a net exporter and has shown a steady growth rate over the past five years.

To address the issues of the sector comprehensively, the Department of Animal Husbandry and Dairying is undertaking various schemes/programmes. It is implementing the scheme of National Livestock Mission since the financial year 2014-15. In view of the present need of the sector, the NLM scheme has been revised and realigned from FY 2021-22.

The Government led by Prime Minster Narendra Modi has announced setting up of Rs. 15,000 crore Animal Husbandry Infrastructure Development Fund under Aatmanirbhar Bharat Abhiyan stimulus package. In respect of promotion of manufacturing, the Ministry of Commerce and Industry, has undertaken several policy measures like Make in India, Ease of Doing Business, Reduction of Compliance Burden, Creation of Industrial Corridors, Implementation of PM GatiShakti, Schemes of Production Linked incentives and Start ups, etc.

I commend the organisers and participants of the national symposium and wish CLFMA of India success in all its future endeavours.
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MESSAGE

I am glad to know that CLFMA of India, Mumbai Maharashtra, is organizing their 55th Annual General Meeting and 63rd National Symposium on the theme ‘Changing Dynamics of Animal Agriculture in India’ on 30th September 2022 and 1st October, 2022 at Hotel The Leela, Mumbai, Maharashtra.

Livestock Industry today is at the crossroad and everyone concerned to Livestock Sector has to work hard to show the right direction to this sector in the coming years in the order to become globally competitive.

With a growing population, climate change and a looming feed availability crisis, the need for Livestock Sector to transit from the traditional industrial model into a new futuristic and sustainable mode is more demanding and looking at this context, the theme has been well selected by CLFMA of India.

This theme will be a very good platform for sharing new ideas to face the future challenges of the sector.

I acknowledge the focused efforts by CLFMA of India towards the overall development of Livestock and its allied sectors.

On the occasion of the 55th AGM and 63rd National Symposium 2022 of CLFMA of India, I extend my best wishes to the organizers and participants for the grand success of the event.

(Dr. Sanjeev Kumar Balyan)
30.08.2022
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MESSAGE

I am pleased to know the CLFMA OF INDIA is organising its 55th Annual General Meeting (AGM) and the 63rd National Symposium on the theme “Changing Dynamic of Animal Agriculture in India” in Mumbai, Maharashtra.

India has vast livestock resources including poultry and fisheries. It is an important source of income as well as nutrition for landless and marginal farmers and plays an important role in the national economy. Agricultural diversification through animal husbandry is one of the primary drivers for increased rural income. The Government of India is making all efforts to promote growth in the livestock sector and change the dynamics of agriculture by involving farmers in animal husbandry. Technological advances have also helped in the betterment of livestock breeds, increased production and productivity and have made a commendable contribution in economy.

The theme of the symposium “Changing Dynamics of Animal Farming of India” is well suited for an agricultural-dominated country like India where both agriculture and livestock industry are interlinked and play an important role in employment generation and income. I hope that this symposium will serve as a platform to share new ideas and techniques to increase animal agriculture and production and its outcomes will help face future challenges in the livestock industry of India.

On the occasion of the 55th Annual General Meeting of CLFMA of India and their 63rd National Symposium, I convey may best wishes to the organizers and participants of the event.

(Om Birla)
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MESSAGE

I am happy to know that CLFMA of India is organizing their 55th Annual General Meeting and the 63rd National Symposium on the theme ‘Changing Dynamics of Animal Agriculture in India’ on 30th September and 1st October, 2022 in Mumbai.

The theme is befitting in the Animal Husbandry sector of current decade where the shift in sector is obvious from livelihood generation to entrepreneurship generation. The technological interventions in the form of precision animal feeding, modern breeding and management techniques, disease prevention and value addition of livestock edible products realized the shift smoother.

CLFMA has always been at the forefront to intervene and notify the feed related issues to Government of India. Being the key stake holder in the livestock feed sector, CLFMA contributed a lot to address the market volatility of the feed ingredients. I appreciate and acknowledge the focused efforts of CLFMA for the holistic development of livestock sector.

I believe that the 63rd National Symposium organized by CLFMA would bring out the concrete suggestions for the advancement of the sector.

On this occasion, I extend my best wishes for the grand success of the event.

(Dr. O.P. Chaudhary)
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It is heartening to learn that CLFMA of India is organising the 63rd National Symposium and will be releasing a Souvenir on the occasion.

The theme of the event, “Changing dynamics of Animal Agriculture in India”, is rightly set considering the fact that the livestock landscapes in India is intensifying rapidly with changing times. A robust digital infrastructure can help revolutionise the Indian Animal Agriculture and strengthen the position of farmers engaged in livestock rearing with increased production, productivity, income and waste reduction.

I am certain that this symposium will give an opportunity to all the stakeholders including industry, farmers, government, academicians and other associated organisations to join their hands and work towards achieving sustainable growth in the livestock sector in India.

My best wishes for the success of the symposium and publication of the Souvenir.

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Mr. Neeraj Kumar Srivastava  
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REF: Thank you for the invitation to your 63rd National Symposium

Dear Mr. Srivastava,

On behalf of the International Feed Industry Federation (IFIF) I would like to thank you very much for your kind invitation to the inaugural session of your 63rd National Symposium on 30 September 2022.

It would have been an honor for us to attend and join you and the Indian Feed Industry colleagues at this special occasion.

Unfortunately, we are not available on that date but IFIF appreciates the support and strong collaboration with CLFMA OF INDIA. 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.

Please do not hesitate to contact me or Alexandra de Athayde, IFIF Executive Director, should you have any questions, and we wish you much success for your Symposium!

Sincerely,

Ruud Tijssens  
Chairman  
International Feed Industry Federation

CC: Ms. Chandrika Venkatesh, Executive Director, CLFMA OF INDIA  
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Convenor Address

It gives me great pleasure to welcome you; our esteemed members, delegates, speakers, awardees and guests to the 55th AGM and 63rd National Symposium of CLFMA 2022. This year, we will explore the 'Changing Dynamics of Animal Agriculture in India'.

The agriculture landscape in India has seen a rise in innovation, use of technology and enhanced farming formats. With increased investments, and the growth of AgriTech startups, the dynamics of Indian agriculture are changing and mapping the Animal Agriculture Industry to be one of the world's most fast growing Agricultural concentrations.

Over the past year, CLFMA has engaged in various activities, hosted panels and conducted meetings with the aim to continue to support and represent the livestock industry. From hosting an Interactive meeting among Indian Livestock Key Stake Holders with Dr. Sanjeev Balyan, Honorable Minister of State of Fisheries, Animal Husbandry & Dairying, Department of Fisheries, Govt. of India, to attending the Conclave on Animal Husbandry Infrastructure Development Fund by the Govt. of India; CLFMA is constantly addressing the ever-changing trends and challenges faced by the livestock industry.

With ever evolving digital and market connectivity, one of the topics we have chosen to highlight and discuss this year is: Go-to-Market Strategies in Dairy, Poultry and Aqua Products. With India's rapidly increasing population, climate change and a persistent food security crisis, the need to address the Changing Dynamics of Animal Agriculture has never been more pressing.

Another important discussion will be based on FSSAI & BIS Regulations and how they impact animal agriculture businesses. Our eminent speakers will help us navigate what the future holds for this industry, and how we at CLFMA can work with the Government to align our goals.
With that, I would like to encourage you all to engage and interact during the Symposium. With our collective effort that we have the power to shape the future of the livestock industry.

Thank you again dear esteemed members, delegates, speakers, awardees and guests for attending, and I would like to extend my personal heartfelt greeting to you all.

Suresh Deora,

[Signature]

Convenor - Hon. Secretary
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Chairman's Address

It gives me immense pleasure to welcome you all to CLFMA OF INDIA’s 55th Annual General Meeting and 63rd National Symposium 2022 on 30th September & 1st October 2022 at Hotel “The Leela Mumbai”.

I extend my sincere thanks to the esteemed dignitaries, Guests of Honour, eminent speakers, key government officials, and participants from different parts of the country and abroad and making this program a resounding success.

CLFMA has successfully completed 55 eventful years and getting stronger year on year with the support of CLFMA members and the managing committee. Last year, CLFMA interacted with various stakeholders in the industry and government on policy-making related to the livestock sector. CLFMA has a diverse membership from across the animal protein value chain including feed manufacturing; poultry, dairy, and aquaculture business; animal nutrition and health, veterinary services, machinery, and equipment; processing, distribution, and retailing of meat.

“We made it”. Last year, we witnessed an unmatched galaxy of Hon’ble Ministers, senior policy makers and regulatory authorities along with several shining stars of the industry and academia and that was a very successful event for CLFMA.

This year’s 63rd National Symposium 2022 is quite unique as we are focusing on the most relevant topic and the current challenge of the industry around the theme “Changing Dynamics of Animal Agriculture in India”.

India has traditionally been a mixed farming economy with agriculture and livestock playing complementary roles. It has been acknowledged that livestock sector makes important contribution to food security and poverty reduction. India’s livestock industry is getting transformed faster in tandem
with the positive macro-economic and demographic factors that look quite favourable in the medium to long run. For example, India is the largest milk producer. India is ranked 1st in milk production contributing 23% of global milk production. Milk production in the country has grown at a compound annual growth rate of about 6.2% to reach 209.96 million tonnes in 2020-21 from 146.31 million tonnes in 2014-15. As of now, freshwater aquaculture contributes to about 88% of the total farmed fish production in India. However, of late brackish water aquaculture production has been progressing at a relatively much higher rate and its share in total production has increased from around 3% ten years back to more than 12% at present. Poultry is one of the fastest-growing segments of the agricultural sector in India today. While the production of agricultural crops has been rising at a rate of 1.5 to 2 percent per annum, that of eggs and broilers has been rising at a rate of 8 to 10 percent per annum. We strongly believe the country’s fast-growing livestock sector offers an ocean of opportunities for those who are willing to explore.

Animal Agriculture in India facing several important challenges: it needs to become more sustainable and productive, while it must remain profitable for farmers. This is particularly true for livestock farming. Some of the areas of concern, that the livestock sector in India is facing viz. shortage of feed and fodder, loss of traditional cattle breeds, inadequate infrastructure, and contribution to global warming.

Change is the only constant in the universe and every day newer inventions, discoveries, and ideas continue to emerge. This year’s theme, “Changing Dynamics of Animal Agriculture in India” will focus on modern and innovative ideas, finding out the solutions to the problems, which the industry is facing and how to overcome these challenges by adopting the latest cloud-based technologies, which will transform the animal-agribusiness sector in unimaginable ways.

Livestock sector in India is getting transformed at much faster pace. However, like other industries our sector needs a skilled workforce and sharp minds. This year, we have a glittering galaxy of eminent speakers, who would be sharing their perspectives on strategies to mitigate price increases of feed ingredients, how to enhance farmer to consumer connect and thus enhance the better realization of prices of their produce, to update on existing and upcoming regulations viz. GST, FSSAI, BIS and so on.
I am much confident that the 63rd Symposium will be a great opportunity for the confluence of innovative and path-breaking ideas that will take the sector to newer heights in the future.

I am grateful to all our sponsors for their patronage, continuous and wholehearted support to CLFMA and its initiatives. I thank all the Office Bearers, Members of the Managing Committee, other members of the association, and delegates for their great support and active involvement, as always.

I look forward to seeing you soon at Hotel The Leela, Mumbai.

With Regards,

Neeraj Kumar Srivastava
Chairman
CLFMA OF INDIA
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# PROGRAMME

**CLFMA 55th AGM & 63rd National Symposium 2022**

*30th September & 01st October, 2022*

Hotel The Leela Mumbai, Andheri - Kurla Road,
Near Mumbai International Airport, Andheri East, Mumbai

"Changing Dynamics of Animal Agriculture in India"

## Day-1 - Friday, September 30, 2022

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>08:30 hrs</td>
<td>Registration of Delegates</td>
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<tr>
<td>10:00 hrs -11:00 hrs</td>
<td>Managing Committee Meeting</td>
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<tr>
<td>11:30 hrs</td>
<td>55th Annual General Meeting</td>
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<tr>
<td>13:00 hrs</td>
<td>Lunch</td>
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<tr>
<td><strong>Inaugural Session</strong></td>
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<tr>
<td>14:00 hrs</td>
<td>Inauguration &amp; Lighting of Lamp</td>
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<tr>
<td>14:10 hrs</td>
<td>Welcome Address</td>
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<tr>
<td>Mr. Suresh Deora, Convenor &amp; Hon. Secretary, CLFMA OF INDIA</td>
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<tr>
<td>14:15hrs</td>
<td>CLFMA AV Launching &amp; Chairman Address</td>
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<tr>
<td>Mr. Neeraj Kumar Srivastava, Chairman, CLFMA OF INDIA</td>
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<tr>
<td>14:30 hrs</td>
<td>Thematic Address</td>
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<tr>
<td>Mr. Balram Singh Yadav, Managing Director, Godrej Agrovet Limited</td>
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<tr>
<td>14:40 hrs</td>
<td>Thematic Address</td>
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<tr>
<td>Dr. O. P. Chaudhary, Joint Secretary (NLM/PC), Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India.</td>
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<tr>
<td>14:50 hrs</td>
<td>Keynote Address</td>
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<td>Shri. Jatindra Nath Swain, IAS, Secretary (Fy), Department of Fisheries, Ministry of Fisheries, AH&amp;D, Government of India.</td>
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<tr>
<td>15:10 hrs</td>
<td>CLFMA Awards Ceremony</td>
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<tr>
<td>15:20 hrs</td>
<td>Address by Guest of Honour</td>
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<td>Shri. Radhakrishna Eknathrao Vikhe Patil, Hon’ble State Minister of Revenue, Animal Husbandry &amp; Dairy, Govt. of Maharashtra</td>
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<tr>
<td>15:35 hrs</td>
<td>Address by Chief Guest</td>
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<tr>
<td>16:05 hrs</td>
<td>Launching Souvenir &amp; Survey Report</td>
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<tr>
<td>16:10 hrs</td>
<td>Vote of Thanks</td>
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<tr>
<td>Mr. Divya Kumar Gulati – Deputy Chairman, CLFMA OF INDIA</td>
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<tr>
<td>19:00 hrs</td>
<td>Networking Dinner &amp; Live Performance</td>
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### Day-2: - Saturday, October 01, 2022

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>09:00 hrs</td>
<td>Registration</td>
<td>Mr. Neeraj Kumar Srivastava, Chairman</td>
</tr>
<tr>
<td>10:00 hrs</td>
<td>Welcome Address</td>
<td>Mr. Kumarjit Mazumder, Head – Sales &amp; Strategy, RMSI Cropalytics Pvt. Ltd.</td>
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<tr>
<td><strong>Session-1: Mitigating the Challenges of Price Escalations of Feed Ingredients</strong> &lt;br&gt; <strong>Moderator: Mr. Amit Saraoji, Managing Director, Sarawagi Agrovet Pvt. Ltd.</strong></td>
<td>10:10 hrs Crop Map, a tech solution to optimize business across Livestock Agriculture value chain &lt;br&gt; Outlook of Corn &lt;br&gt; Insights on Soymeal Demand &amp; Availability &lt;br&gt; Soybean meal access for Animal Feed sector &lt;br&gt; Mr. Prerana Desai, Head of Research, Samunnati Agri. &lt;br&gt; Mr. Kevin M Roepke, Regional Director-South Asia &amp; Sub-Sahara Africa (SAASSA) USSEC &lt;br&gt; Mr. Hemant Bansal, Vice President, Ruchi Soya Ind. Ltd., Vice President Indian Vegetable Oil Processors Association</td>
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<tr>
<td>11:45 hrs</td>
<td>Global Experiences of Go To Market Approaches</td>
<td>Dan Meagher, President &amp; CEO, Novus International, Inc.</td>
</tr>
<tr>
<td><strong>Session -2: Go To Market Strategies: Dairy, Poultry &amp; Aqua Products</strong> &lt;br&gt; <strong>Moderator: Mr. Balram Singh Yadav, Managing Director, Godrej Agrovet Limited.</strong></td>
<td>Direct to consumer approaches &lt;br&gt; • Poultry Products &lt;br&gt; • Dairy Products &lt;br&gt; • Mr. B. Soundararajan, Chairman Suguna Group &lt;br&gt; • Mr. Bhupendra Suri, CEO, Creamline Dairy &lt;br&gt; Domestic Marketing of Shrimp: Need of the hour in India &lt;br&gt; Dr. Manoj M. Sharma, Aquaculture Expert, Mayank Aquaculture Pvt. Ltd.</td>
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<td>13:30 hrs</td>
<td>Lunch Break</td>
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<tr>
<td><strong>Session-3: Regulations (FSSAI, BIS) &amp; Potential Impact on Animal Agriculture</strong> &lt;br&gt; <strong>Moderator: Dr. P. S. Mahesh, Joint Commissioner and Director CPDO &amp; TI, Govt. of India</strong></td>
<td>14:30 hrs Panelist &lt;br&gt; Dr. Ashish Patkar, Honourable Vice Chancellor, Maharashtra Animal &amp; Fishery Sciences University (MAFSU) &lt;br&gt; Panelist &lt;br&gt; Dr. Parminder Singh, Professor Animal Nutrition (Extension), Dept. of Veterinary &amp; Animal Husbandry Extension Education, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU.) &lt;br&gt; Panelist &lt;br&gt; Dr. Amit Sharma, Director, Trade and International Cooperation, Food Safety and Standards Authority of India (FSSAI), Govt. of India &lt;br&gt; Panelist &lt;br&gt; Mr. Amit Choudhary, Joint Director, Bureau of Indian Standards (BIS), Mumbai Branch, Ministry of Consumer Affairs, Food and Public Distribution, Govt of India.</td>
<td>Q&amp;A &lt;br&gt; All the Speakers</td>
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<td><strong>Valedictory Session</strong></td>
<td>16:15 hrs Summation of Symposium &lt;br&gt; Shri. Tarun Shridhar, IAS (Retd.), Former Secretary, Dept. of AH &amp; D, Ministry of Fisheries, Animal Husbandry &amp; Diarying</td>
<td>16:30 hrs Felicitation of Sponsors, Media, Guests and Invitees &lt;br&gt; Mr. Suresh Deora – Convenor &amp; Hon. Secretary &lt;br&gt; 17:25 hrs Vote of Thanks &lt;br&gt; 19:00 hrs Networking Dinner</td>
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Er. Anand Menon
FIE

- Born in Vijayawada, Anand Menon had his schooling in the famous Hyderabad Public School, Begumpet and took his engineering from MIT, Manipal.

- A graduate Mechanical Engineer and a Fellow of the Institute of Engineers, he has 45 years’ experience in Vegetable Oil Industry, Animal Feed Manufacturing, Milk processing and Ice Cream Manufacturing.

- His career started in Delhi at Chemical Construction International and he worked in Faridabad, Kharad and Manilla, Philippines, for about seven years before returning to India to join Kerala Solvent Extractions at Irinjalakuda, Kerala.

- This Rs.2 crore turnover Company grew over the years to a Rs 1500 cr turnover Company (and later becoming KSE LTD. a listed Public Limited Company,) and was at the helm of affairs as CGM, till he retired at the end of 2018.

- From a single unit, non-profit making Company, eight factories (Cattle Feed, Solvent Extraction, Veg. Oil Refining, Milk Processing) were added during these years in Kerala, Tamil Nadu and Karnataka (later disinvested), making it a dividend paying profitable Company; the largest Cattle Feed Manufacturing and largest solvent extracting Company processing Coconut cake, of India.

- During these years, there were no prolonged strikes and industrial relations were best despite involvement of various Trade Unions (CITU, INTUC, TUCI, BMS). The Company provides employment to over 1200 people directly and an equal number indirectly.

- The Rs 10/ Company share today stands at Rs2200/Share. As advised by the promoters, it has been a privilege to be a shareholder (one among the five largest non-promoter shareholders) and enjoy the attractive Dividends paid each year by the Company, highest being 1000%, in 2018.
He was the:

- Chairman CLFMA of India,
- Chairman, South Zone and National Executive, SEA of India.
- President, Cochin Chamber Of Commerce and Industry, Kochi.
- President, Thrissur Management Association, Thrissur.
- President, Architects and Engineers Association, Thrissur.
- District Governor Lions Clubs International, D1.324E2, (Kerala)
- President, Thrissur Table Tennis Association.
CLFMA Award

Dr. Rudra Nath Chatterjee
FELLOW, ELECTED 2025

Born at Burdwan, West Bengal, India on 1 January, 1965.


Current Position: Director, ICAR - Directorate of Poultry Research, Rajendranagar, Hyderabad, 2011 to date.

Service: Assistant Professor, Mathura Veterinary College (CSAU), 1992-99, Senior Scientist, Central Agricultural Research Institute, Port Blair, 1999-2005; Senior Scientist & Principal Scientist, Project Directorate on Poultry, Hyderabad, 2005 - 2010.

Awards/Honours/Recognition: ICAR Team Research Award, 2001-02; Fakhruddin Ali Ahmed Award 2002-03; Hari Om Ashram Trust Award 2010-11; Sardar Patel Outstanding ICAR Institution Award (Small Institute category) 2013 (as Director, DPR); Chiarman, Ap Chapter of IPSACON (2011-2014); Member, Committee for Compartmentalization of Poultry Farms (GOI), 2011 to date.


Expertise / Research Areas: Animal Genetics & Breeding, Poultry Breeding, Molecular Genetics.

Contact Details: Address: Director, ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad - 500030, Telangana.
Flat No. 101, Moghal Meadows-1 Upperpally, Hyderabad 500048, Telangana (Tel: off. (040) 24015656 & 24011313; Res. (040) 24011314, Cell: 9652052462, 9441295044; Fax (040) 24017002; Email: rnc65@gmail.com; rncchat@rediffmail.com)
Amit Saraogi
MD Anmol Feeds Pvt Ltd.

Mr. Amit Saraogi, Co-founder and Managing Director, Anmol Feeds Pvt. Ltd. is driven to combine innovation and compassion to create value-driven products for all stakeholders. With an entrepreneurial mindset, Anmol Feeds was started in the year 2000 at Muzaffarpur and then it was a growing graph for the organization. He is a self-made man who turned a small business venture into the 600-crore company that employs over 800 employees today while dominating the Eastern, Northern and North Eastern Indian market. Driven to combine innovation and compassion to create value-driven products for all stakeholders, he transformed his company into a well-oiled machine. He has built a professional team that has transformed the business into an organized one in a rather unorganized industry to emerge as a leader and pioneer of the sector.

His leadership skills have earned Anmol Feeds a string of prestigious awards. Besides his role at Anmol Feeds, he also plays an important part at various chambers. He is the Chairman for Livestock, CII for of Eastern Regional Council and the Charter member of TiE, Kolkata, a non-profit venture for entrepreneurs & investors. He was the past chairman of CLFMA, the apex livestock industry body. He is also the Director Member of MCC Chambers of Commerce & Industry. He is dedicated to lead the organization in a direction that will be instrumental in the development of the nation.
Mr. Kumarjit Mazumder is a business and innovation expert who has commercialized and scaled several SaaS businesses in his illustrious career of more than a decade now, with companies such as Tally ERP, PineLabs, Nokia and RMSI. Kumarjit leads Sales efforts for RMSI Cropalytics across India & International markets.

Prior to RMSI, he held several positions at Tally and Pine Labs where he was tasked at creating innovative tech based businesses to solve for automation in industries like Retail, e-Commerce, manufacturing, trading, utilities and services. Enabling businesses with various tech solutions, understanding customers and surpassing their expectation is core to his competency.
Ms Prerana Desai
Head of Research, Samunnati Agri

Ms Prerana has a vast experience of commodity research of more than 25 years. She specializes in Agri Commodity Research. As a part of her vast experience she has done commodity research for various value chain participants like manufacturer, trader, exchange, commodity broker, NBFC and now farmers. Samunnati Agri enterprise consist of all those business entities offering products as well as services pertaining to inputs, production, transportation, processing and marketing in agricultural as well as allied sectors such as animal husbandry, fisheries, poultry, forestry and so on. Samunnati Agri offers solutions to cater to the needs of value chains operating in the agricultural space. Samunnati follows Aggregation, Market Linkage, as well as Advisory services (AMLA) approach. Samunnati facilitates market access through financial and non-financial solutions that enable the enterprises and associated value chains to operate at a higher equilibrium, thereby creating value for all stakeholders. SamAgr is the Advisory service that is also available for consultation at a fee.
Mr Kevin Ropke
Regional Director, South Asia and Sub-Saharan Africa, USSEC

Regional Director, South Asia - Sub Sahara Africa, USSEC Mr. Kevin Roepke serves as the Regional Director of South Asia - Sub Sahara Africa for the US Soybean Export Council (USSEC). Roepke is chiefly responsible for the strategy and implementation of market and trade development for US SOY within South Asia. Before this position, he was the Regional Director for the Americas, based in Mexico. Before joining USSEC, Roepke worked in various positions with the US Grains Council, most recently serving as regional director for South and Southeast Asia and Oceania, based in Kuala Lumpur, Malaysia. Additionally, Roepke worked on many complex trade issues for the US Grains Council, posted in Beijing, China and Washington, DC. Before his work in membership associations, he was with Archer Daniels Midland’s (ADM) oilseed processing division, where he was responsible for the Western Divisional soymeal export position. Roepke is a graduate of Iowa State University with a degree in Public Service and Administration in Agriculture and was recently honoured with 2018.

Statement Maker Award for Outstanding Alumni. He is also the co-founder of an app that won the American Farm Bureau 2018 AgTech Startup of the Year. He received an MBA from the Massachusetts Institute of Technology (MIT) in Cambridge, MA. As a native Iowan, Roepke grew up on a livestock operation and was actively involved in showing and judging cattle and hogs while in 4-H and FFA.
Mr. Hemant Bansal  
Ruchi Soya Ind. Ltd (Vice-President)

He is Vice-President in Indian Vegetable Oil Processors Association (IVPA).

IVPA is an apex body of Vegetable Oil Producers and was formed in the year 1977 and formally registered in 1979 which represents stake holders from across the Edible Oil Value Chain. The vision of IVPA is to Promote Sustainability, Economic Growth and Excellence in the Edible Oils and Oilseeds Value Chain in India. IVPA has a Mission to be the Credible Voice of the Indian Oils & Oilseeds Industry Players. IVPA advocate and provide inputs for Policies that increase Stakeholders' Value and Spur Economic Growth in the country through continued investment & innovation, ensuring sustainability of Supply Chains to deliver Safe and Healthy products for the growing Population.

Mr. Hemant Bansal is presently working with RUCHI SOYA INDUSTRIES LTD. as Business Head (Vice President) – Crushing & Commercial. He has almost 20 plus years of experience in Oil & Oil Seed Procurement/Trading, managing Oilseeds Crush/Refining plant & Brand Management. In the last 20 years, he has been associated with companies like ITC, Reliance, Spencer's, Cargill, ADM India, Patanjali Ayurved & Ruchi Soya Industries Ltd. in multiple capacities.

Ruchi Soya Industries Limited is the leading soybean & mustard crusher in India having multiple crushing/refining plants located in all strategic geographies of India along with refineries in almost all major sea ports. As on today RSIL is a Part of Patanjali Group. RSIL/Patanjali is one of the leading FMCG brands in India and especially in the Indian edible oil sector. RSIL is the largest manufacturer of soya & mustard by-products (edible/non edible) with a presence across the value chain in up/downstream sectors.
Balram Singh Yadav
Managing Director, Godrej Agrovet Ltd.

Balram Singh Yadav is the Managing Director of Godrej Agrovet Ltd. (GAVL), one of India’s foremost diversified agribusiness companies. He also serves as Managing Director of Godrej Tyson Foods Ltd. Besides, he is a Director of numerous firms including ACI Godrej Agrovet Pvt. Ltd. - Bangladesh, Creamline Dairy Products Ltd. - Hyderabad, Astec Lifesciences Ltd, and Godrej Maximilk – Mumbai. He has been the Chairman of CLFMA of India (Twice), an Association of Livestock Industry.

Balram began his career with Godrej in 1990 and over the years he has handled roles of increasing responsibility across businesses and regions in the company. He became the business Head in 1999 when he was asked to establish & lead the Poultry Business. He established the Real Good Chicken and Yummiez as the leading processed poultry brand in India.

In 2007, he took over reins of Godrej Agrovet Ltd. as Managing Director. As his first challenge, he successfully led the turnaround of GAVL, which was then a loss-making entity and put it on the path of rapid growth. In 2017, Balram was instrumental in taking the GAVL public. The public offer received record response & was subscribed over 96 times. Over the last decade, GAVL topline has grown at a Compounded Annual Growth Rate of 15%, unlocking significant value for the shareholders.

A raconteur par excellence, Balram inspires his team with incredible stories from his rich experience in the field, only when he’s not driving them to deliver their best. He’s also an active angel investor mentoring a slew of next-generation entrepreneurs.

Balram completed his BSc (Hons) in Agricultural Science at Haryana Agricultural University, where he ranked 2nd in his class. He earned his MBA from IIM-Ahmedabad. He lives in Mumbai.
Bringing over 35 years of experience in the agriculture industry to this role, since April 2020 Mr. Meagher has led Novus International, Inc., with the goal to transform the company into a leader in animal health through nutritional solutions for the protein-producing global food system.

Mr. Meagher served as the president and CEO of Boston-based animal nutrition and health company Agrivida Inc. There Mr. Meagher led the company’s strategy and commercialization of a new generation of enzyme solutions with the aim of transforming the economics of agricultural food production by feeding higher-efficiency, corn-expressed protein solutions.

Mr. Meagher’s career has a strong foundation in agriculture. Until 2007 he served as president of the Egg Products division at Moark, LLC based in Missouri. There he managed the strategic partnership with Land O’ Lakes Inc. and successfully consolidated multiple business unit acquisitions and completed the sale of the business. Prior to Moark, he was the chief operating officer and executive vice president at start-up MBA Poultry LLC where he strategically positioned and marketed the first air-chilled poultry product to consumers in the United States. Mr. Meagher began his career with Ralston Purina/Purina Mills, where he spent 17 years in roles of increasing responsibility, including vice president, income management and operations, and president of Golden Sun Feeds.

He has served on multiple boards during his career including the American Feed Industry Association (AFIA) since 2007, the National Chicken Council (NCC) since 2014, the Biotechnology Innovation Organization (BIO), the Agrivida Board of Directors, and the United Egg Producers (UEP) Further Processor since 2020 where he served as association chairman.

A native of Saint Louis, Missouri, Mr. Meagher holds bachelor’s degrees in finance and accounting from Saint Louis University.
B Soundararajan
Founder and Chairman
Suguna Group

Born in 1961, Mr. B. Soundararajan is a first-generation entrepreneur, whose life's motto has always been the same from the beginning, which is to enrich the lives of rural India. Originally hailing from Udumalpet, a town not far away from Coimbatore, Tamil Nadu, he went on to found Suguna Group of Companies along with his younger brother Mr. G.B. Sundararajan.

He currently serves as the Managing Director at Suguna Holdings Private Limited and as a Director in its subsidiaries including overseas Companies.

Suguna is one of the pioneers in the country to start the contract farming in poultry industry which reshaped the country's poultry farming and also created a robust and effective system in poultry management. Mr. Soundararajan's business interests lie in poultry, Diary and animal healthcare. He has globalized Suguna Group's business activities by setting up business ventures abroad. The current overseas subsidiaries are located in Sri Lanka, Bangladesh and Kenya. Each year, he studies the economy of various countries and looks for potential business opportunities. He is an efficient strategist and an able executor who could convert ideas into action spontaneously.

Under his leadership, Suguna Foods has provided livelihood to 45,000+ farmers and has been ranked 3rd in Asia's top poultry producers list and also ranked as the 9th largest poultry company globally. Being the market leader in the broiler business in India.

The founder has been instrumental in raising the living standards of poultry farmers since Suguna's inception. He provides direct/indirect livelihood support to more than 2 lakh people across India through the concept of 'Poultry contract farming'. Moreover, with efficient business models, he has also made the broiler chicken an affordable source of protein for the common people of India. This way, Suguna Group is playing an important role in ensuring the food security of our country.
Mr. Soundararajan has won numerous awards for his works. He won the Best Performance Award from National Productivity Council, New Delhi—7 times in 8 years; Young Entrepreneur Award from CII; Lifetime Achievement Award from TIE, Chennai; Asian Livestock Industry Award from Malaysian Government. Innovator to the core, Mr. Soundararajan pioneered the concept of 'Contract Farming' in India. Through his innovative business concepts, Under his guidance, Suguna has so far distributed more than 5 million trees saplings and donated educational aids to many schools in rural areas. He also set up the Suguna Institute of Poultry Management (SIPM), a non-profit organization and a partner in the Skill India program. Every year, SIPM trains youngsters of rural areas, transforming them into successful entrepreneurs and skilled employees in the poultry industry.
Bhupendra Suri
CEO

Bhupendra Suri is the CEO of Creamline Dairy Products Limited. He is currently responsible for driving sustainable growth in Creamline dairy products through focus on building “Godrej Jersey” brand of Milk and Dairy products by setting up best in class procurement, operations & route to market. His prolific career spans nearly three decades of which 23 years were with Coca-Cola where he performed various roles in Sales, Distribution, Supply Chain, RTM and Franchise Bottling Operations. He led Coca-Cola’s national Franchise Bottling Operations business in India. He was the Managing Director of Coca-Cola Nigeria till 2019. His last stint was as CEO for Devyani Food Industries Limited where he was responsible for running the Creambell Ice-cream business in India. He has also worked with Bajaj Auto Limited and Asian Paints Limited. Bhupendra did his B Tech from IIT BHU, Varanasi and completed his PGDBM from XLRI, Jamshedpur. Bhupendra is an avid reader and a published author of two books.
Dr. Manoj M. Sharma
Shrimp Aquaculture Farmer

About
A pioneer Shrimp farming professional with more than 26 years of experience in the sustainable shrimp farming practices. Played a major role behind the development of “Blue Revolution” in Surat District of Gujarat where the transformation of coastal (khar) wasteland into the productive shrimp producing land.

Education
Doctor of Philosophy (PhD) in Fisheries Science (shrimp farming) from Swami Ramanand Teerth University, Nanded, Maharashtra, India.
Master of Fisheries Science (M.F.Sc.) in Fisheries Management from Central Institute of Fisheries Education. (Deemed University, ICAR), Mumbai, India.

Area of Interest
- Sustainable Shrimp Farming
- Recent technologies and intervention
- Probiotics and multispecies rearing

Publications
- Presented paper in all world famous Aquaculture conferences like World fisheries society, Aqua India, Viv Asia, NFDB, TARS (The Aquaculture round table series), Aqua show Ecuador, Aqua conference, Mexico National conference focusing on Best Management Practices and sustainability in the shrimp farming
- Writes regular article on Tips to successful shrimp farming in Aquaculture spectrum magazine.

Core competences
- 26 + on field experience in shrimp / fish aquaculture practices
- Experience in probiotics and food processing
• Efficient resource management
• Efficient finance and asset management
• Efficient business strategy
• Problem solving and attention to details
• Team Leadership and Skilled orator

Contribution to the field
• Played an important role in the development of sustainable shrimp farming in Gujarat, India with more than 6000 ha. area benefiting thousands of rural people and coastal fishermen.
• Developed the shrimp industry in Gujarat to the value of 2500 crores benefiting lakhs of individuals directly or indirectly.
• Developed the concept of satellite shrimp farming which has brought manifold increase in shrimp production in Gujarat.
• Played a key role in the development of GAA (Gujarat Aquaculture Association) where all the Gujarat based farmers and fishermen gain knowledge and technology interventions for their individual benefit.
• Promoted reverse migration as the rural village people got a source of income up to 5 to 6 lakhs per annum for themselves which removed there dependency on the urban cities for their livelihood.
• Imparted the technical expertise in the shrimp culture practices at various platforms which made it accessible to all the fishermen community especially the women community which made them self-reliant.

Awards and Honors
• Recipient of “Best BW Shrimp/Fish farmer- Coastal states” award for year 2018 from NFDB (National Fisheries development board), Hyderabad.
• Received prestigious “India’s Small Giants” award from India SME forum for year 2014.
• Awarded by ICAR (Central Institute of Fisheries education) for “Leadership in Fisheries & Aquaculture” year 2014-15.
• Received BEST FISH FARMER AWARD from Central Institute of Fisheries Education, Mumbai on Fish 8th July, 2005.
• Recipient of Agrivision award 2020 for the exceptional contributions to the field of shrimp farming from Akhil Bhartiya Vidyarthi Parishad.
Dr. Mahesh Subhash Patlapati  
B.V.Sc., M.V.Sc., PGPPM (IIMB)

- 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 GoI & Director of Central Poultry Development Organization & Training Institute (CPDO&Tl), Government of India, a premier Poultry Training Institute of India.

- 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, Compounded Livestock Feed Manufacturers Association (CLFMA), 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 GVK, 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
Col (Dr.) Prof. Ashish Motiram Paturkar

Prof. Ashish Motiram Paturkar, born on June 22, 1962, in Buldhana district of Maharashtra state, India, graduated with a Bachelor of Veterinary Science and Animal Husbandry in 1986 and did M.V.Sc. in 1988 and Ph.D. in 2002 in the discipline of Food Hygiene and Veterinary Public Health. He has more than 30 years of teaching, research, and extension experience. He has worked on almost all the University’s senior academic and administrative posts.

He has handled several research projects funded by ICAR, World bank, MOFPI, Govt. of India, ICAR, ICMR, IIP and APEDA, DST, RKVY, BARC, TATA Trust etc. He has published 69 articles in journals of National and International repute and guided 33 Post-Graduate students and 5 Ph.D. students. He has received 18 Awards and Honours and published/contributed chapters in 11 Books.

He has established NABL Accredited Western Region Referral Laboratory for Meat and Meat Products Quality Standards under NATP. He has standardized and validated various protocols for detecting pesticide residues in meat, milk, and eggs. His primary research areas are food preservation and improving the shelf life of meat and meat products. He is co-developer of a prototype of Model Chicken Retail outlet, which has been popularized and adopted, Flow Through Assay and ELISA kit for diagnosis of Cysticercosis and Hydatidosis respectively. He is a co-developer in 4 technologies/diagnostic tests developed and applied for their patent.

He joined Alma Matter University as Vice Chancellor on January 22, 2018. After taking over the reign of MAFSU as Vice-Chancellor, he has brought several positive changes in the administration of the University.

In August 2019, Prof. Paturkar was awarded CLFMA Award, considering his service excellence in the Livestock Sector field. Dr. Paturkar was also admitted as a Fellow of the National Academy of Veterinary Sciences (India) in December 2019. He was awarded India Animal Health Award 2022 in the category of Research Leadership for impactful research on Food Hygiene and Veterinary Public Health at India Animal Health Summit 2022 on July 07, 2022, organized by the Indian Chamber of Food and Agriculture (ICFA) at New Delhi. He is also bestowed Dr. C. M. Singh Samman, 2022 Scroll of Honor presented to him on May 30, 2022, on the Occasion of Dr. C. M. Singh Birth Centenary Year Celebrations at GADVASU, Ludhiana Punjab.
Dr. Parminder Singh is working as Professor Animal Science (Extension) in Directorate of Extension Education GADVASU, Ludhiana. He worked initially with Pfizer Ltd before joining the university. He travels extensively in the state and motivates the dairy, poultry, pig and goat farmers to adopt balanced and scientific feed. He is excellent orator and has delivered more than 1200 lectures to farmers, associations, doctors and feed millers in various parts of India. He also coordinates meetings of dairy, poultry and pig farmers conducted at university campus. He is working on the nutrient requirements of high yielding animals to produce desired levels of SNF, Fat and Milk Yield. His areas of interest are mineral requirements, developing need based trace minerals, antibiotics and aflatoxins levels in feed. He keeps close watch on the feed additive segment. He is working on the value addition of feed particularly Calf Starter, Heifer, Transitional and Therapeutic Feeds. He has worked closely with poultry farmers to develop herbal eggs. He has coordinated 31 courses for cattle feed manufacturers conducted by university in which approximately 1460 cattle feed millers participated. He also taught 53 (UG & PG) courses. He has guided 6 MVSc & 2 Phd students. He has handled five research projects. For his meritorious work, he was given Achievement Award in Dairy Nutrition by CLFMA in 2016 at Kolkata.
Mr. Amit Choudhary
Joint Director, Mumbai Branch Office 1, BIS

Mr. Amit Choudhary is a Joint Director posted at Mumbai Branch Office 1 of Bureau of Indian Standards under the Ministry of Consumer Affairs, Food and Public Distribution, Govt. of India. He has done his Masters in Inorganic Chemistry from Vinoba Bhave University, Hazaribagh and has been working with BIS since 2010. In his tenure in BIS, he has worked in the Central Laboratory, Product Certification, Consumer Engagement & E Enforcement. He is trained for Occupational Health and Safety Management System, ISO 45001, Quality management System ISO 9001. He has worked for various conformity assessment schemes under BIS. He has been actively involved in conducting consumer and industry awareness programmes for Standards, BIS standard Marks and various Product Certification schemes.
Dr. Amit Sharma
Director

Educational Qualification:
M.V.Sc. (Gold Medal), MBA
Lead Auditor for ISO 9001, ISO 22000 and ISO 17020

Serving as Director at Food Safety and Standards Authority of India (FSSAI), Ministry of Health & Family Welfare in Trade & International Cooperation Division. Previously worked at Export Inspection Council, Ministry of Commerce & Industry, Govt. of India as Joint Director where involved in export inspection & certification, addressing market access issues, trade barriers, coordinated audit of Indian official control by DG SANTE of EU, FSIVSPS (Russia), GACC (China), SFDA (Saudi Arabia), DVS (Malaysia) etc.

For past more than 15 years, he is involved in addressing food safety issues at national & international level, interacting with importing regulatory authorities and taking up SPS/ TBT issues to facilitate trade. Dr. Sharma has a wide experience of standard setting at national & international level, food safety audit for domestic, import and export.

Dr. Sharma has several articles and national awards to his credit.
A former IAS officer of the 1984 batch of Himachal Pradesh cadre.

Retired in July, 2019 as Secretary to the Government of India (GoI) Ministry of Animal Husbandry, Dairying & Fisheries. Presently Member, Central Administrative Tribunal

• More than 35 years experience in high positions of policy making and implementation.

• Prior to holding the position of Secretary, Government of India, he was Additional Chief Secretary in the Government of Himachal Pradesh. As Additional Chief Secretary, he looked after diverse sectors and departments such as Power, Personnel, Revenue, Environment and Forest, Horticulture, Industries, Animal Husbandry, Fisheries etc.

• He has earlier held the position of Joint Secretary in the Department of Animal Husbandry, Dairying & Fisheries, Government of India for 5 years. Nearly ten years of combined experience in the state and central governments in Animal Husbandry, Dairying and Fisheries sectors.

• Deputy Commissioner of Mandi and Bilaspur districts; SDM Kangra; Assistant Commissioner Development, Pacchhad; Managing Director HP Tourism Development Corporation and Himachal Road Transport Corporation

• More than 100 articles, both in English and Hindi published in reputed publications such as the Indian Express, The Tribune, Outlook, Dainik Jagran, Dainik Bhaskar and myriad technical journals on the subjects of Sustainable Development, Agriculture, rural Development, One Health, Dairying, Pastoral Economy, Livestock Management, Fisheries, Disaster Management etc.
• Regular participant in international and national technical workshops on Animal Husbandry, Poultry, Dairy, Fisheries and allied sectors as a resource person and keynote speaker

• A varied 360 degree experience, knowledge with innovative initiatives in various fields of industry, infrastructure, education, public welfare, administration, governance reforms, policy and implementation.
Introduction

Industry is challenged with disposal problems for the vast amounts of animal wastes produced by intensive, large-scale animal production facilities (Natural Resources Conservation Service, 1995), plant-processing wastes, rejected fruit and vegetables, and other food wastes which can be used as livestock feed and it may seem to be a practical and economic way of using or disposing of such materials. However, animal products may contain unacceptable chemical residues when any such waste material is fed without proper treatment and this chemicals can be utilized in the growing animals safely after appropriate treatment.

Waste can be classified in several ways based on its nature and the source from which it is derived. Based mainly on its natural resource, food waste can be divided into plant-derived food waste and animal-derived food waste. Plant derived food waste either can be classified as per their origin and processed level which are described in the figure 1. Similarly, animal origin wastes can be classified in to the slaughter waste or farm waste. Depending upon the waste type potential hazard and processing methods can be utilized. For the general plant origin wastes different types of drying methods are used with different time temperature combination to prevent the further growth of the microorganism with the help of nutrients and moisture combination. But processing of animal waste is bit tricky due to high uncertain chemicals in it and it need proper processing which are described further in next section of article.

![Fig. 1: Classification of wastes](image)

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India produces about 38.33 million tonnes of poultry manure annually (Prabakaran and Valavan, 2021). Farmers have turned to mix this poultry wastes into livestock feed, in part as a means of disposal. In addition, wastes retain some nutritional value and can partially substitute for more expensive feeds, cutting feed costs. Thus, “recycling” by feeding appears to be a potentially profitable alternative to land disposal of wastes. Its nutritive value depends on several factors including the species of the type of bird producing the waste, the kind and quantity of other feedstuffs, the way the excreta is treated, and the species to which the treated excreta is fed.

**HEALTH HAZARDS**

Quality control systems are essential to ensure that any materials fed to stock, and the final livestock products, meet stringent residue standards.

1. **Chemical**

Generally, there are no specific systems in place to prevent the occurrence of unacceptable chemical residues in these waste materials. Various metals, drugs, and other chemicals are often administered to animals in their feed for nutritional and pharmaceutical purposes. Poultry waste has been shown to contain varying levels of arsenic, which can accumulate in the livers of animals ingesting it (Messer et al., 1971). Cadmium, zinc, lead, and nickel can also be passed in animal wastes. Just as veterinary chemicals are not to be used for the weeks preceding slaughter, animal waste is not generally used as feed for animals during the 2 weeks preceding slaughter to allow drug residues to dissipate from tissues. This is not, however, subject to regulatory enforcement nor is there any evidence that pre-slaughter withdrawal of animal wastes from feeds eliminates intestinal pathogens.

2. **Hormones**

Estrogenic hormones are present in the poultry excreta (Mathur and Common, 1969) and the urine of cycling cows (Mellin and Erb, 1966). Callantine et al. (1961) reported that the combined daily fecal and urinary excretion of Diethylstilbestrol (DES) averaged 63% for cattle fed 10 mg DES per head daily for 168 days. Westing and Brandenburg (1974) reported no DES residues were detected in a ration containing 14% beef feedlot waste. However, no indication of the level of DES in the waste or ration was given. These studies indicate that although estrogenic hormones are present in animal waste, the level is sufficiently low so as not to be detected in a manure-formulated ration.

**b. Heavy Metals**

The presence of lead and cadmium in beef feedlot waste was reported by Westing and Brandenburg (1974) at levels of 12.7 ppm and 0.61 ppm, respectively, on a dry basis. The only documented evidence of harmful effects of feeding animal waste to animals is copper toxicity in sheep-fed broiler litter with high copper levels. Fontenot et al. (1972) reported that 64% of ewes fed 50% broiler litter for 254 days died of copper toxicity and 55% died that had consumed 25% litter in their ration. The liver copper levels at death or slaughter were significantly higher for the ewes fed 25 or 50% litter than those fed the control ration. The litter contained an average of 195 ppm copper and the rations containing 0, 25, and 50% litter analyzed 17.8, 57.1, and 109.1 ppm copper.

**c. Antibiotic residue**

Ensiling reduced the level of sulfathiazole from 71.3 ppm to 43.6 ppm after fermentation. Zinc bacitracin was present initially in the corn litter mixture (0.095 units per gram) but not detected in the fermented mixture (Caswell et al., 1977). Webb and Fontenot (1975) analyzed broiler litter collected from different broiler houses for drug residues and reported penicillin, oxytetracycline, chlortetracycline, neomycin, and zinc bacitracin. A feeding study was conducted using 25% and 50% of the litter in rations for steers. Following a 5-day withdrawal period of not feeding the litter rations, the animals were slaughtered and the tissues were analyzed for antibiotic residues. When litter containing some of these residues was fed to cattle, there was no problem with tissue residues following a 5-day withdrawal of litter. Antibiotic residues in bovine waste resulting from their use in feeding ration also do not appear to be a serious problem.
2. Biological

In 1967, the Food and Drug Administration (FDA) issued a Statement of Policy and Interpretation related to the use of poultry litter in animal feed. It concluded: Disease organisms may be transmitted from poultry to other animals through the use of poultry litter as animal feed. There are several diseases affecting poultry that can also affect cattle, hogs, and sheep as well as man. Thus, such transmission of disease organisms from poultry to other animals and possibly to man constitutes a hazard to animals and public health (Wempe et al., 1983). Some of the potential pathogens in poultry litter were identified by Alexander et al. (1968). From 44 samples of litter, they isolated 10 species of Clostridium, two species of Corynebacterium, three species of Salmonella, and two mycobacteria isolates.

a. Bacteria

Chicken wastes are a well-known source of salmonella and campylobacter. Although not frequently used as feed, cattle manure also harbors dangerous organisms. In USDA feedlot samplings, E. coli 0157:H7 were found in 1.5 to 6.1% of cattle (Herriott et al., 1995). In tests at 100 feedlots, E. coli 0157:H7 were found in 1.6% of manure samples taken from the pen floor, and 63% of feedlots had at least one positive sample (Dargatz, 1995). Survival of even small numbers of bacteria can be dangerous. Some strains of Salmonella typhimurium are so highly infectious that ingestion of fewer than 10 cells can cause disease in susceptible individuals (Fontenot, 1991).

b. Viruses

Viruses, unlike most bacteria, are more infectious and require a living host for propagation. In feeds, they may persist for days or even months (Cunliffe and Blackwell, 1977). In a study of the incidence of viruses in manure 17 of 22 samples of liquid manure from a swine, house yielded enteroviruses, adenoviruses, and a coronavirus, but no viruses were isolated from 18 samples of liquid dairy cattle manure (Derbyshire, 1976). Aeration of swine waste inoculated with swine enterovirus was reported to rapidly inactivate the virus.

• PROCESSING TECHNIQUES TO REDUCE THE RISK OF HEALTH HAZARDS

Recycling animal waste as a feed ingredient represents a departure from normal feeding practices and may result in an increased incidence of pathogens. It is not expected that rations formulated with animal waste be sterile since most feeds contain substantial numbers of microorganisms.

1. Stacking

Deep stacking is a process in which wastes are piled to a height of about 1.5 m, which causes spontaneous heating and dehydration which are intended to inactivate pathogenic microorganisms (Fontenot and Webb, 1975). McCaskey and Martin (1988) found it to be effective for reducing the risk of pathogens. However, inactivation of some salmonella species requires temperatures of approximately 63°C (145°F), and killing E. coli requires heating to 68°C (155°F) (Dargatz, 1995). The temperatures achieved in stacked poultry litter are variable, typically in the range of 43 to 60°C (110 to 140°F) (Tharp and Miller, 1994). The higher the moisture content, the lower the maximal temperature.

2. Ensiling

Ensiling is an economical method of preserving and rendering manure silages safe from potentially pathogenic microorganisms. Ensiling waste may offer other advantages as improvement of nutrient composition, improved palatability, and convenient use of silage feeding equipment. During the ensiling process, lactic acid-producing bacteria that occur naturally on plant material ferment water-soluble carbohydrates to lactic and acetic acids. The production of acid, the toxic effect of the developed acids, and the rapid establishment of anaerobic conditions suppress the activities of undesirable microorganisms.

Knight et al. (1977) reported that Streptococcus faecalis was the predominant acid-producing bacterium in waste blended rations before fermentation. Following ensiling for 10 days, the predominant acid producer was L. Plantarum which is also the predominant organism in forage.
The effect of ensiling animal waste on the survival of 27 salmonellae cultures (comprising several serotypes) was studied by McCaskey and Anthony (1975). The ration consisting of 45% ground shelled corn, 15% corn silage, and 40% wet bovine manure was inoculated with each of 27 salmonellae cultures and ensiled at 5, 15, 25, and 35 °C. Following 4 days of ensiling, 21 of the 27 salmonellae survived at 5 °C, 25 survived at 15 °C, 1 survived at 25 °C, and none survived in the rations ensiled at 35 °C for 4 days. Based on this study, safety criteria were developed for eliminating salmonellae from ensiled bovine manure-blended rations. The researchers recommend that during ensiling, the temperature of the ensilage must be 25 °C or higher to effect sufficient development of acid required for elimination of salmonellae. The minimum pH for growth of salmonellae reported by Chung and Goepfert (1970) was pH 4.4 for lactic acid-adjusted culture media and pH 5.4 for media acidified with acetic acid. McCaskey and Anthony (1975) reported that salmonellae proliferated in culture media adjusted to pH 5.0 with lactic acid, but no growth occurred at pH 4.0.

One study showed that while initial levels of total bacteria and coliforms were quite high in all samples, ensiling did cause a marked reduction at all moisture levels (Caswell et al., 1978). Elimination of bacteria from fermented waste is, in part, a function of pH. Salmonella and E. coli survived 10 days of ensilage in poultry litter, but only 2 days in bovine manure silage (McCaskey and Wang, 1978). Ascarid eggs, Entamoeba histolytica, Giardia lamblia, and tapeworms can remain viable and infective after fermentation processing (Boda, 1990). The survival of nematodes in an ensiled mixture of 57 parts of Coastal Bermudagrass hay and 43 parts of manure (wastelage) was studied by Ciordia and Anthony (1969). All ensiled samples were negative for larvae, although eggs were present in the feaces used in the preparation of the silage. Survival of a mixture of Ostertagia ostertagia and Cooperia oncophora larvae was studied in grass silage acidified with 3.99 kg of 87% formic acid per 0.91 metric ton of grass. At a maximum temperature of 33 °C and pH 4.2, 10% of the larvae were still viable after 40 days ensiling. All larvae lost viability after 50 days. Enigk et al. (1969) reported that oncospheres of Taenia pisiformis and T. saginata were not infectious after storage in grass silage at 20 °C for 80 days.

3. Drying

Heating and drying processes are more effective than deep stacking or fermentation in killing pathogens (Caswell et al., 1975). In a typical system, manure or litter is placed in a drum or disk dryer or a forced air “oven” or is subjected to blasts of hot air by other mechanical means. Temperatures can reach 150°C (300°F) or higher, depending on the method used (McCaskey and Harris, 1982). System designers attempt to minimize heat’s disadvantages, particularly the loss of nitrogen and moisture. Purchase and operating costs and space requirements are the principal factors limiting the use of heat treatment systems.

Tarczynski and Szepelski (1970) studied the effect of various methods of drying on the infectivity of Fasciola hepatica metacercariae. Ventilator drying of meadow grass resulted in the greatest loss of infectivity (60%). Messer et al. (1971) studied the time-temperature combinations necessary to destroy potential pathogens in poultry litter. Salmonella pullorum at 62.8 °C for 30 min; S. typhimurium at 62.8 °C for 60 min; and Escherichia coli at 68.3 °C for 30 minutes. Fontenot et al. (1971) reported that dry heat treatment of 150 °C for 3 hr was required to sterilize broiler litter. Heating the litter for less time or treatment with beta propiolactone or ethylene oxide was ineffective in completely sterilizing the litter. Payne et al. (1973) developed a mathematical model for predicting the microbial lethality of heat required to sterilize poultry waste.

Caswell et al. (1975) evaluated several heating methods of processing litter to determine their effect on pasteurization and nitrogen retention. The methods evaluated were 150 °C for 10 to 20 min, 150 °C for 15 min with the addition of 1.0% paraformaldehyde, moist heat (autoclaving) at 121 °C for 5 to 30 min, and ethylene oxide fumigation at 22 °C for 30 to 120 minutes. The effectiveness of the treatment processes on broiler litter was evaluated using milk pasteurization criteria, i.e., less than 20,000 total viable bacteria and less than 10 coliform bacteria per gram following pasteurization. All treatment methods, except the 30-min ethylene oxide fumigation, reduced the coliform count of the litter from more than 30,000/g to a non-detectable level after heating. Longer
periods of fumigation were effective in destroying coliforms. Cross et al. (1974) determined the effect of drying time and temperature on the survival of microorganisms in turkey litter. Gram-negative bacteria were killed after drying the litter for 3 hr at 150 °C and anaerobes were destroyed by drying at 200 °C for 1 hour.

4. Pelleting

An examination of feeds by Zindel and Bennett (1968) failed to reveal salmonellae in pelleted or extruded feeds. Edel et al. (1973) reported that the spread of salmonellae may be prevented by the pelleting of feeds. Heating and subsequent drying during pelleting destroy salmonella. Pelleting would also appear to be an effective method of eliminating potentially pathogenic organisms in waste blended rations.

5. Chemical

Treatment of poultry litter by chemicals has been evaluated as a means for destroying pathogens. Messer et al. (1971) evaluated ethylene oxide and cobalt-60 radiation for sterilization of poultry litter. Cobalt-60 radiation eliminated microbes but ethylene oxide only reduced the microbial population. Harry et al. (1973) observed that S. typhimurium was susceptible to 40 mg/l methyl bromide at 25 °C for 20 hours. Organic acids have been used to preserve haylage, silage, and wet brewers' grains and these acids would appear to have the potential for preservation and destruction of pathogenic organisms in manure formulated rations. Propionic acid has been reported to retard fungal spoilage of haylage and high moisture grain (Thomas, 1976) and its use in animal waste rations may be beneficial to prevent risk from mycotoxins.

**CONCLUSION**

Animal wastes have been used successfully in animal feeding programs for several years without significant problems related to animal health. Potential health problems appear to be of minor importance after processing the wastes as it eliminates many of the potential hazards. It is generally agreed that waste-formulated rations should be processed to reduce the potential risk of disease dissemination. The only reported health problem associated with feeding waste occurred with ewes fed boiler litter containing high copper levels. Although studies have demonstrated that the practice of recycling animal excreta by feeding can be safe, additional research is needed to demonstrate safety from potential health hazards that have not been previously evaluated. The use of any product for animals carries with it an inescapable and undetermined risk but, by choosing appropriate processing method for the waste utilization based on cost, the efficacy of the method, target waste product and animal species to be fed; we can reduce the risk of health hazard.

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India is the highest Milk producing country in the world. In the year 2021 its milk production was around 209.96 Million Tonnes and a per capita availability of 427 gms/day. The country produces around 21% of the entire milk production and is growing at a rate of around 5.80 % per annum. The growth of Indian Dairy Sector is undoubtedly due to the effective Development Schemes such as Operation Flood (I and II), National Programme for Dairy Development (NPDD) National Dairy Plan –I, Dairy Processing and Infrastructure Development Fund (DIDF) and very recently The Animal Husbandry Infrastructure Development (AHIDF).

Indian Dairy sector is in terms of consumption of milk and milk products. The dairy sector has witnessed tremendous Technological and business environmental changes. There is an adoption of advanced technology throughout the entire dairy value chain and similarly the dairy consumers taste and preferences have changed drastically. The Indian Dairy has a tremendous potential for growth and success, however this potential can truly be unlocked only by highly competent and highly skilled Dairy Professionals. Hence, the need of the hour is to ensure a regular supply of professionally qualified dairy professionals who can take Indian Dairy industry ahead. Though, the Dairy Education begin way back in the year 1921, still there is much to be done in this area. At present there are around 20 dairy colleges in India which can supply 754 Dairy Graduates, 154 Post graduates and 21 Doctorate dairy professionals annually. From academic year 2022-23 the number is expected to rise to around 25 colleges including new private colleges. According to a study conducted by the authors a few years ago it was estimated that the supply of Dairy Professionals would be greater than their demand, due to which by year 2020-21, there would be a surplus of around 352 Dairy Graduates, 232 Dairy Post-Graduates in the country. A second area of concern was the ‘placement of female candidates’ as most of the dairy plants run in shifts. Third issue is that of ‘Geographically Uneven supply of Dairy Professionals’. The number of colleges in East is only 2 but it has 13 states and similarly Number of colleges in North is only 4 but it includes 9 states. The number of colleges is relatively much more in West and South regions. Gujarat has 4 Dairy Science Colleges while “Madhya Pradesh” has milk production nearly equal to Gujarat has no Dairy Science College. This situation may seem to be adverse since dairy plants prefer dairy professionals to be Son of dairy farmer/ Son of Soil. Also a fourth issue is that of Shortage of Teaching faculty in the college. When the existing strength of teaching faculty in Dairy Science Colleges was compared with the Minimum department wise and cadre wise Strength as suggested in the ICAR’s 5th Dean’s Committee report, it was found that, in the 19 dairy science colleges which gave their responses for the study, there is a shortage of 14 Professors, 168 Associate Professors, and 491 Assistant Professors. Other developments which need to be focussed are – Establishing a Dairy Council of India, Recognition of the Dairy Technology degree by AICTE, etc.

Various remedies such as reservation for female candidates, promoting dairy entrepreneurship etc., Starting Post –graduate courses in Dairy Management field can be suggested for improving the situation.

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ANIMAL AGRICULTURE – WILL INDIA FOLLOW GLOBAL DYNAMICS?

G. Chndrashekhar

Globally, meat consumption is shifting towards poultry and India is no exception. It is not surprising because the Indian market is known to be price-conscious. Lower poultry prices drive consumption. As incomes rise, consumers' food habits will evolve and they will move up the value chain.

But price is not the sole consideration. Beyond lower prices, consumers are attracted to poultry because of product consistency a well as higher protein/lower fat content. Poultry meat will represent over 40 percent of all protein from meat sources in the next ten years.

Without doubt, the animal agriculture sector faces several challenges including disease outbreaks, sanitary restrictions and trade policies, to name a few. Interestingly, poultry is in a position to respond more quickly to market signals because of shorter production cycle as compared with ruminants.

Importantly, poultry sector lends itself to quick changes in genetics improvement, animal health and feeding practices. Equally important is the fact that greenhouse gas emissions will slow as the poultry sector expands.

While it is well recognized that animal agriculture enjoys tremendous potential, we need to create a 'sustainable animal agriculture ecosystem'. Participants in the animal agriculture market need to recognize that they will be only as good as the ecosystem permits them to be sustainable. So, a constant quest for improvements in technologies, services, standards and regulations is called for.

Land constraints, water shortage, climate change, low crop yields, low level of technology penetration and policy constraints can potentially stymie the growth of this sector in future.

There are other challenges including uncertainty of raw material / feed availability, affordability and access; feed price volatility; demand fluctuation and policy environment. But most critical could turn out to be the major advances seen in plant protein that can impact animal meat demand. The western countries are already witnessing gradual shift away from animal protein to plant protein, especially among the environmentally conscious younger generation.

The OECD-FAO report has recognized that 'Consumers' growing environmental and health-consciousness is expected to support a transition from animal-based protein towards alternative sources of protein, which consumers perceive as healthier alternatives'.

India’s nutrition challenge is well recognized. Undernutrition and protein deficiency is pervasive. As much as 70 percent of the population is not averse to eating meat. The animal agriculture industry has a great opportunity to meet the burgeoning protein need. But can it?

Animal protein cost is prohibitive as compared with plant protein. Animal protein will have to compete with plant protein cost-to-cost in order to meet the country’s protein challenge. So, the animal agriculture industry needs to introspect and design strategies that would make its protein more affordable.

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INCREASING INCOME OF FARMERS IN INDIA

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The major problems faced by the farmers (Crop and Animal farmers) in India include lack of resources, mechanization, agricultural marketing, scarcity of capital, small land holding, climate changes, minimum use of modern technologies, and above all the natural calamities like heavy or very low rainfall, drought, and floods. All these factors are responsible for poor productivity. The reasons for low productivity are the non-use or low-use of fertilizers and even the use of farmyard dung manure is also not sufficient.

Indian Livestock Sector gives employment to 8.8% of the population, contributes 4.11% out of a total agricultural GDP of national level of 25.6%. In spite of above listed number of constraints the farmers face, the population of livestock is 545.3 million in India. The above calculations are based on data of the Department of Animal Husbandry, Dairying, and Fisheries, Ministry of Agriculture, Govt. of India. The country has the second largest population of cattle, the highest numbers of buffalo and third highest number of sheep, second highest number of goats, and seventh level of poultry in the world. With this large population of livestock, India is the highest producer of milk, third in eggs and second in fish production.

With such a large production of livestock products, Indian farmers have a very low per capita income. The Government of India has a lot of schemes for the upliftment of their income. Maximum emphasis had been given to a scheme “Doubling Farmers Income”. Doubling farmers' income (DFI) is a target set by the Government of India in February 2016 to be achieved by 2022-23. The household income of farmers in 2015-16 was Rs 8,059 per month and this should have been Rs. 21,146 after neutralization of inflation during these five years in the financial year 2022-23. The household income was Rs. 8,059 in 2015-16, it increased to Rs. 10,218 in 2018-19, and projected income will be Rs. 12,445 in 2022-2023, but the targeted value for this period was Rs. 21,146. There is a large gap in target and achievement.

Now the question arises how to increase farmers’ income. The support price of different crops may be increased immediately depending upon the cost involved in production of that crop in the field. Animal farmers should be provided health care of animals either free of cost or at the minimum price which the farmers can afford. Good quality balanced ration should be provided to the farmers so that milk production should be further increased. There are many feeds based on plants containing secondary metabolites which can inhibit methanogenesis in the rumen and might increase feed conversion efficiency and improve milk and meat production. At the same time methane inhibition might cause lower global warming and protect the climate from the adverse effects of greenhouses gases. Therefore, immediate action is needed to protect the farmers from increasing inflation and give them a chance to live respectfully. In addition to that by increasing farmers’ income, the movement of the youth of rural area to cities to find jobs will be either stopped or at least reduced.

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CHANGING DYNAMICS OF ANIMAL AGRICULTURE IN INDIA

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Brief

Animal agriculture refers to the rearing and production of livestock resources including poultry through animal husbandry and dairying activities and fisheries production through aquaculture practices. Both the livestock and fisheries sector are crucial to the Indian economy. Approximately, 20.5 million and 14.5 million people are depended on the livestock and fisheries sector respectively for their livelihood. In addition to providing millions of people with affordable and wholesome food, they also play a key role in fostering gainful employment in the rural sector, notably among the landless, small and marginal farmers, and women. India has one of the largest livestock industries in the world. As per the 20th Livestock Census, India has nearly 851.81 million poultry, 303.76 million bovines (cattle, mithun, buffalo and yak), 148.88 million goats, 74.26 million sheep, and 9.06 million pigs population (DADH, 2022). It contributes around 30.47% to agricultural GVA (Gross Value Added) and 6.17% to total GVA of the country. India continues to be the world’s top producer of milk. The average milk production was estimated at 209.96 million tonnes (MT) in 2020-21 with per capita availability of 427 g/day. Similarly, the average egg production in 2020-21 was determined as 122.05 billion numbers with per capita availability of around 90 eggs/year. The meat production has shown a positive growth (with 8.80 MT production in 2020-21) while the wool production has shown a negative growth (with production of 36.93 million kg in 2020-21) in the last 10 years. Moreover, India produces 7.6% of the world’s fish today, placing it as the 3rd largest fish producer in the world. Fish production of the country has increased from 0.75 MT in 1950-51 to an all-time high of 14.73 MT in 2020-21 with 11.25 MT contributed from the inland sector and 3.48 MT from the marine sector (DOF, 2022). Over the past 25 years, inland fisheries have seen a transition from capture to culture fisheries. Freshwater aquaculture part of inland fisheries, which was 34% in mid-1980, has climbed to roughly 76% in recent years. More recently, shrimp farming has increased the financial benefits of agricultural communities compared to earlier times, encouraging people to succeed in shrimp cultivation rather than other forms of agriculture. The total shrimp production has reached to the level of 8.44 lakh tonnes with 8.16 lakh tonnes contributed by Litopenaeus vannamei and 0.28 lakh tonnes by Penaeus monodon. During the financial year 2021-22, India exported 1.37 million metric tonnes of seafood worth Rs. 57,586.48 crores (USD 7.76 billion) (MoCI, 2022). Recently the changing dynamics in the livestock and fisheries production has led the government to focus more on the sector. In this line Government of India (GoI) has approved various packages for the respective sectors. GoI has announced several schemes and mission for the livestock sector with total outlay budget of Rs. 54618 crores for the development in the next five years. Likewise, GoI has approved a flagship scheme namely “Pradhan Mantri Matsya Sampada Yojana (PMMSY)” in the fisheries sector with a total investment of Rs. 20050 crores for a period of 5 years (2020-21 to 2024-25).

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CHANGING DYNAMICS OF ANIMAL AGRICULTURE IN INDIA

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Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8% of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% of national GDP and 25.6% of total Agriculture GDP. The value of export of livestock and livestock products during 2017-18 was Rs. 457.76 billion while value of import was Rs. 104.24 billion. As per estimate of National Sample Survey undertaken on employment, it was revealed that livestock sector is engaging 16.44 million workers in the activities of farming of the animals, mixed farming, fishing and aquaculture. India’s livestock sector is one of the largest in the world. As per the 20th livestock census of Department of Animal Husbandry and Dairying (DAHD) held in 2019, the total livestock population in India was 535.82 million, which include 192.52 million cattle, 109.85 million buffaloes, 74.26 million sheep, 148.88 million goats, about 9.06 million pigs, 851.81 million poultry population and 0.85 million other livestock population.

The livestock sector is highly dynamic. In developing countries, it is evolving in response to rapidly increasing demand for livestock products. The demand for livestock products have been largely driven by human population growth, income growth and urbanization and the production response in different livestock systems has been associated with science and technology as well as increases in animal numbers. In the future, production will increasingly be affected by competition for natural resources, particularly land and water, competition between food and feed and by the need to operate in a carbon-constrained economy. Developments in breeding, nutrition and animal health will continue to contribute to increasing potential production and further efficiency and genetic gains. Livestock production is likely to be increasingly affected by carbon constraints and environmental and animal welfare legislation. Demand for livestock products in the future could be heavily moderated by socio-economic factors such as human health concerns and changing socio-cultural values.

CHANGING DYNAMICS OF ANIMAL AGRICULTURE

(a) Genetics and Breeding

Domestication and the use of conventional livestock breeding techniques have been largely responsible for the increase in livestock products yield. At the same time, considerable changes in the composition of livestock products have occurred. Previous changes in demand for livestock products have been met by a combination of conventional techniques, such as breed substitution, crossbreeding and within-breed selection, future changes are likely to be met increasingly from new techniques. Of the conventional techniques, selection among breeds or crosses is a one-off process, in which the most appropriate breed or breed cross can be chosen, but further improvement can be made only by selection within the population. Cross-breeding, widespread in commercial production, exploits the complementarity of different breeds or strains and makes use of heterosis or hybrid vigour. There is much more potential in the use of crosses of Exotic breeds with local breeds that are well-adapted to local conditions. In the future, we will see a continuing trend in which livestock breeding will focus on other attributes in addition to production and productivity, such as product quality, increasing animal welfare, disease resistance and reducing environmental impact. The tools of molecular genetics are likely to have considerable impact in the future. For example, DNA-based tests
for genes or markers affecting traits that are difficult to measure currently, such as meat quality and disease resistance, will be very useful. Another example is transgenic livestock for food production; these are technically feasible, although the technologies associated with livestock are at an earlier stage of development than the equivalent technologies in plants. In combination with new dissemination methods such as cloning, such techniques could dramatically change livestock production. Complete genome maps for poultry and cattle now exist, and these open up the way to possible advances in evolutionary biology, animal breeding and animal models for human diseases. Genomic selection should be able to at least double the rate of genetic gain in the dairy industry, as it enables selection decisions to be based on genomic breeding values, which can ultimately be calculated from genetic marker information alone, rather than from pedigree and phenotypic information. New tools of molecular genetics may have far reaching impacts on livestock and livestock production.

(b) Livestock Nutrition

The nutritional needs of farm animals with respect to energy, protein, minerals and vitamins have long been known. Various requirement determination systems exist in different countries for ruminants and non-ruminants, which were originally designed to assess the nutritional and productive consequences of different feeds for the animal once intake was known. However, a considerable body of work exists associated with the dynamics of digestion, and feed intake and animal performance can now be predicted in many livestock species with high accuracy. A large agenda of work still remains concerning the robust prediction of animal growth, body composition, feed requirements, and the outputs of waste products from the animal and production costs. Such work can be helpful in improving the efficiency of livestock production and meeting the expectations of consumers and the demands of regulatory authorities. Advances in genomics, transcriptomics, proteomics and metabolomics will continue to contribute to the field of animal nutrition and predictions relating to growth and development.

Poor nutrition is one of the major production constraints in smallholder systems, particularly in India. Much research has been carried out to improve the quality and availability of feed resources, including work on sown forages, forage conservation, the use of multi-purpose trees, fibrous crop residues and strategic supplementation.

There are also prospects for using novel feeds from various sources to provide alternative sources of protein and energy, such as plantation crops and various industrial by-products. Another important aspect that will affect livestock nutrition is the need to mitigate greenhouse gas emissions. Improved feeding practices can reduce methane emissions per kilogram of feed intake or per kilogram of product. Many specific agents and dietary additives have been proposed to reduce methane emissions, including certain antibiotics, compounds that inhibit methanogenic bacteria, probiotics such as yeast culture and propionate precursors such as fumarate or malate that can reduce methane formation.

(c) Health care

Animal diseases generate a wide range of biophysical and socio-economic impacts that may be both direct and indirect, and may vary from localized to global. The economic impacts of diseases are increasingly difficult to quantify, largely because of the complexity of the effects that they may have, but they may be enormous. The last few decades have seen a general reduction in the burden of livestock diseases, as a result of more effective drugs and vaccines and improvements in diagnostic technologies and services. At the same time, new diseases have emerged, such as avian influenza H5N1, which have caused considerable global concern about the potential for a change in host species from poultry to man and an emerging global pandemic of human influenza.

Future disease trends are likely to be heavily modified by disease surveillance and control technologies. Potentially effective control measures already exist for many infectious diseases. Recent years have seen considerable advances in the technology that can be brought to bear against disease, including DNA fingerprinting for surveillance, polymerase chain reaction tests for diagnostics and understanding resistance, genome sequencing and antiviral drugs. There are also options associated with the manipulation of animal genetic resources, such as cross-breeding to introduce genes into breeds that are otherwise well-
adapted to the required purposes, and the selection via molecular genetic markers of individuals with high levels of disease resistance or tolerance.

POSSIBLE MODIFIERS OF FUTURE LIVESTOCK PRODUCTION AND CONSUMPTION TRENDS

(a) Competition for natural resources like land and water

The mixed crop–livestock systems will continue to be critical to future food security, as two-thirds of the global population live in these systems. Some of the higher potential mixed systems in Africa and Asia are already facing resource pressures, but there are various responses possible, including efficiency gains and intensification options. Increasing competition for land in the future will also come from biofuels, driven by continued concerns about climate change, energy security and alternative income sources for agricultural households.

Globally, freshwater resources are relatively scarce, amounting to only 2.5 per cent of all water resources. Groundwater also plays an important role in water supply: between 1.5 and 3 billion people depend on groundwater for drinking. Increasing livestock numbers in the future will clearly add to the demand for water, particularly in the production of livestock feeds. More research is needed related to livestock–water interactions and integrated site-specific interventions, to ensure that livestock production in the future contributes to sustainable and productive use of water resources.

(b) Climate change

Climate change may have substantial effects on the global livestock sector. Livestock production systems will be affected in various ways and changes in productivity are inevitable. Increasing climate variability will undoubtedly increase livestock production risks as well as reduce the ability of farmers to manage these risks. At the same time, livestock food chains are major contributors to greenhouse gas emissions, accounting for perhaps 18 per cent of total anthropogenic emissions. Climate change will have severely deleterious impacts in many parts of the tropics and subtropics, even for small increase in the average temperature.

(c) Socio-cultural modifiers

Social and cultural drivers of change are having profound effects on livestock systems in particular places, although it is often unclear how these drivers play out in relation to impacts on livestock and livestock systems. Livestock have multiple roles in human society. They contribute substantially and directly to food security and to human health. For poor and under-nourished people, particularly children, the addition of modest amounts of livestock products to their diets can have substantial benefits for physical and mental health. Livestock’s contribution to livelihoods, particularly those of the poor in developing countries like India is well recognized. Livestock generate income by providing both food and non-food products that the household can sell in formal or informal markets. Livestock also serve as financial instruments, by providing households with an alternative for storing savings or accumulated capital, and they can be sold and transformed into cash as needed and so also provide an instrument of liquidity, consumption smoothing and insurance. For some poorer households, livestock can provide a means of income diversification to help deal with times of stress. In addition to their food security, human health, economic and environmental roles, livestock have important social and cultural roles.

Conclusion

Several assessments agree that increases in the demand for livestock products, driven largely by human population growth, income growth and urbanization, will continue for the next three decades at least. Globally, increase in livestock productivity in the recent past have been driven mostly by animal science and technology, and scientific and technological developments in breeding, nutrition and animal health will continue to contribute to increasing potential production and further efficiency and genetic gains. Demand for livestock products in the future, could be heavily moderated by socio-economic factors such as human health concerns and changing socio-cultural values.

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POSTBIOTICS A POTENTIAL ALTERNATIVE TO PROBIOTICS
– A NEW PERSPECTIVE FOR CHANGING DYNAMICS
OF ANIMAL AGRICULTURE IN INDIA

Dr. S. Senthil Murugan M.V.Sc., PhD., M.S., PG.D(OH)

Introduction

Antibiotics are added as growth promoter at sub-therapeutic dose in mono gastric animals like poultry and pig to maximize the potential performance. The efficacy of feeding sub-therapeutic levels of antibiotics to modulate gut microbiota to enhance production performance of livestock has been studied and recommended by the scientists. But, the efficacy was determined by gastrointestinal tract (GIT) microbiome complexity (bacteria, fungi, Archaea, protozoa, and virus) dominated by bacteria. The gut microbiota can create a protective barrier by attaching to the epithelial walls of enterocytes, thereby reducing the possibility of colonising pathogenic bacteria. However, using antibiotics as growth promoter for long periods in livestock diets lead antibiotic resistance to the host and high residue levels in poultry products such as meat and egg. The alternative growth promoters like probiotics, prebiotics, enzymes, acidifiers, yeast etc are added as feed additives.

What is Postbiotics?

International Scientific Association of Probiotics and Prebiotics (ISAPP) defined the Postbiotics as “preparation of inanimate microorganisms and/or their components that confers a health benefit on the host”. Postbiotics can be looked as deliberately inactivated microbial cells or cell components and have the same effects and benefits as probiotics when ingested by the animal. Further, postbiotics have been defined as any factors resulting from the metabolic activity of a probiotic or any released molecules capable of conferring beneficial effects to the host directly or indirectly and also known as non-viable bacterial products or metabolic by-products from probiotics microorganisms with biological activity in the host.

Composition and Preparation of postbiotics

Postbiotics can be prepared either by using heat or enzymes treatment, or by sonication or ultracentrifugation and solvent extraction. The cell-free biologically active metabolites released in the liquid media are collected as supernatant with cellular substances are given as feed additives in the market. The biologically active metabolites are proteins or peptides, teichoic acids, exopolysaccharides, bacteriocins, short-chain fatty acids (butyrate, acetate, lactate) neurotransmitters, and conjugated linoleic acid of lactic acid bacterial species used for preparation of postbiotics.

How postbiotics are better than Probiotics?

World Health Organization (WHO) declared Probiotics as “live bacteria/microorganisms that may provide health benefits to the host when consumed in sufficient amount.” Whereas, Prebiotics are defined as non-digestible food components that support the growth of probiotics and the beneficial bacteria that exist in the gut so they can flourish. Probiotics are colonizing the host digestive system, increase the natural microbiota and prevent the colonization of pathogenic organisms. But, most bacterial species used as probiotics are plasmid probiotics have antibiotic resistance genes which can be transferred between organisms and efficacy of the probiotics are depend on the is the main limiting factor to use live microbes as probiotics.
Postbiotics as growth promoter

Postbiotics have antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, hypocholesterolemic, hepatoprotective as well as growth promoter properties, which improve the host health. The supplementation of postbiotics increased both the body weight and body weight gain in quails (Kareem, K.Y., 2020). There is a difference in the growth performances of birds fed with postbiotics produced from different strains of Lactobacillus plantarum and at different level of inclusion of postbiotics is also affecting the growth performance of birds (Danladi, et al. 2022). Further, it was evidenced that dietary supplementation of postbiotics significantly increased the number of Lactic Acid Bacteria counts compared with the control and decreased the pathogenic bacteria like E. coli and enterobacteria in the caecum of broilers. These beneficial effects of postbiotics are because of the reduced intestinal pH brought by the volatile fatty acids of postbiotics (Kareem et al., 2016).

The broilers fed with postbiotics with a combination of prebiotics (inulin) improved growth performance and had lower drip loss and increased lightness of the breast muscle. There are no significant effects on the cooking loss, shear force and carcass characteristics (Kareem et al., 2015).

In post-weaning lambs, postbiotics dietary supplementation studies revealed there was significant increase in the populations of cellulolytic bacteria (Fibrobacter succinogenes, Ruminococcus albus, Ruminococcus flavefaciens), total protozoa and improved rumen epithelium and intestinal barrier function, including increased ruminal papillae growth.

Conclusion

In the changing dynamics of Animal agriculture scenario, considering postbiotics along with prebiotics shown better results than probiotics. The active metabolites produced during processing of postbiotics with controlled dose, ensures the growth performance in poultry and pigs.

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NUTRITION AND REPRODUCTION INTERACTION IN DAIRY ANIMALS

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The improvement in genetics and management of the dairy animals throughout the world has created a new era in which minimum numbers of milking animals meet the growing demand for dairy products. In an effort to gain the greatest efficiency and lifetime productivity, cattle and buffaloes are inseminated and pregnancy is established while they are still lactating. Gestation and lactation overlap until the dry period. Therefore, there is an inherent requirement to establish pregnancy in lactating dairy animals. The modernization and consolidation of the dairy industry over the past 25 years or so has created many new challenges. One challenge that will undoubtedly affect future efficiency of the dairy industry is the decline in fertility and reproductive efficiency in modern milking animals. The root cause of the declining fertility is probably a combination of physiological, nutritional and management factors that have an additive effect on reproductive efficiency.

Water, energy, protein, minerals and vitamins are required for normal reproduction. These nutrients are the same as those required for other body processes: maintenance, growth and milk production. The impact of animal’s nutritional status on the reproductive performance may affect their ability to:

- Conceive
  - Provide the proper amount of nutrients to support the growth of a normal foetus
  - Deliver a calf without complications
- Lactation vs Conception
  In early lactation, milk production has the highest priority for the available nutrients. In addition to the nutrients found in the diet, cows & buffaloes tend to mobiles their body reserve (primary energy) to support milk production. Transitional animals cannot eat sufficient amounts during early lactation; thus they are in a state of energy deficiency, they lose weight and their ability to conceive is drastically reduced. It is only at a later stage of lactation, when the energy ingested is in balance with the energy required for milk production, that the ability to initiate a new pregnancy increases.

Energy Balance and Fertility

One of the most common causes of low fertility is the deficiency of energy relative to animal’s need, or negative energy balance. Depending upon the milk production in early lactation, negative energy balance may last for 2-10 weeks of lactation. Conception rates are lower for animals inseminated during negative energy balance (losing weight) compared to the animals inseminated during the positive energy balance (gaining weight). There is no evidence that higher producing miltch animals have inherently lower reproductive ability. However, it is clear that animals with a negative energy balance have lower fertility regardless of milk producing ability.

Protein and Fertility

The effect of dietary protein on reproduction is complex. In general, inadequate amounts protein in the diet reduces milk yield and reproductive performance. Excess protein may also have a negative effect on reproduction. Some of the following effects have demonstrated to explain the poor reproduction sometimes observed with excessive levels of protein in the diet:
• High levels of blood urea may occur, which has a toxic effect on the sperm, the ova, and the developing embryo.

• The balance of hormones may be altered. Progesterone levels are low when blood contains high levels of urea.

• In the early lactating animal, high levels of protein may exacerbate the negative energy balance and delay the return of normal ovarian function.

Feeding protein and urea, such that early lactating cows and buffaloes have a diet containing 16% protein and late lactating ones having a diet containing 12% protein in their total mixed ration, should optimize the fertility in the animals.

Minerals, Vitamins and Fertility

Minerals and vitamins play an important role in reproduction. The effects of severe deficiencies are usually well understood. However, it is difficult to establish possible effects of long term marginal deficiencies or excesses. In addition, there are many interactions between minerals especially the micro minerals. In general, almost all required vitamins and minerals (except iron) have either a direct or indirect effect on the cow’s fertility and the animal’s ability to give birth to a healthy calf. Phosphorus deficiency may greatly delay sexual maturity in heifers and decrease the fertility of dairy animals. Calcium to phosphorus ratio from 1.5:1 to 2.5:1 is desirable in the diet of milking animals.

Progesterone and Fertility

Progesterone is required for pregnancy, and there is an association between low progesterone and infertility. A direct link between low progesterone and embryonic loss has not, however, been established. Other factors associated with nutrition of the cow may affect the ovary and the pregnancy directly, but the two may not be related. For example, undernourished dairy animals have smaller dominant follicles and smaller CL but their inability to become pregnant may be caused by a third mechanism that is unrelated to the changes that occur within the ovary. Finally, the absolute minimum blood progesterone concentrations that are needed for pregnancy in animals are not known.

Progesterone is transferred locally from the ovarian/oviduct venous drainage to the uterine artery. The local transfer results in higher concentrations of progesterone within the uterus. Because of the local transfer, concentrations of progesterone in blood, which are the subject of rates of metabolism and clearance, may be irrelevant when progesterone is delivered to the uterus via the local circulation. Pregnant animals have higher concentrations of blood progesterone within the first week to 10 d after insemination. Poor nutrition and weight loss in milking animals causes a decrease in blood progesterone concentrations. One possibility is that greater milk production in dairy cattle is negatively affecting blood progesterone concentrations and causing infertility in dairy cows.

A number of nutritional products and feeding management strategies can be used as supportive treatment for various metabolic and infectious diseases. Poor nutrition can minimize the incidence or help control metabolic, infectious, and reproductive disorders in dairy herd. It should be noted that infections may complicate a situation and may be the primary factor in some disorders that appear to be entirely metabolic in nature. There are several indicators that a possible nutritional problem exits. Consider the following when evaluating the herd.

• High incidence of metabolic disorders. Usually an incidence greater than 10 to 15% in a herd is considered a problem.

• Poor response to the vaccines

• Higher than normal occurrence of weak or silent heats

• Milk fat content that deviates more or less than 0.3% from breed average

• High incidence of off-flavors in milk, especially rancidity, oxidized or cardboard milk

• Excessive decline in milk production

• Greater than 10% of the herd is classified in the extreme categories of body condition.

• Depressed dry matter intakes
Encouraging a lactating animal to eat large amounts of feed is the key to productive and efficient milk production. Select feeds to ensure maximum intake. All the nutrients the cow or buffalo requires for milk production (except water) are in the dry material of the feed. High dry matter intake (DMI) results in high nutrient intake and high milk yield. Table 1 gives the maximum total DMI (from fodder and concentrate mixture) that milking animals can eat in mid-to-late lactation. The table lists DMI as a % of body weight and in kg per day. A cow weighing 550 kg giving 30 kg milk can eat 3.7% of her body weight in DM daily or about 20.4 kg. A bigger cow (650 kg) at the same milk yield can eat only 3.4% of her weight in DM (22.1 kg per day). Bigger cows at higher milk yield can eat more feed DM.

DMI of milking animals in early lactation may be reduced up to 20% below the values in Table 1. Early lactating cows and buffaloes have reduced appetites. Problems such as difficult calving, milk fever, retained placenta after birth or twisted stomach will further depress DMI. Most animals increase in DMI gradually after calving and peak in DMI by 10 to 12 weeks of lactation. Total ration DM should be between 50 and 70%. Wetter or drier rations limit DM consumption.

Table 1. Dry matter intake by cows in mid to late lactation (% of body weight and kg per day)

<table>
<thead>
<tr>
<th>Cow Body Weight (kg)</th>
<th>Milk Yield</th>
<th>450</th>
<th>550</th>
<th>650</th>
</tr>
</thead>
<tbody>
<tr>
<td>(kg)</td>
<td>%</td>
<td>kg</td>
<td>%</td>
<td>Kg</td>
</tr>
<tr>
<td>10</td>
<td>2.6</td>
<td>11.7</td>
<td>2.3</td>
<td>12.7</td>
</tr>
<tr>
<td>20</td>
<td>3.4</td>
<td>15.3</td>
<td>3.0</td>
<td>16.5</td>
</tr>
<tr>
<td>30</td>
<td>4.2</td>
<td>18.9</td>
<td>3.7</td>
<td>20.4</td>
</tr>
<tr>
<td>40</td>
<td>5.0</td>
<td>22.5</td>
<td>4.3</td>
<td>23.7</td>
</tr>
<tr>
<td>50</td>
<td>5.6</td>
<td>25.2</td>
<td>5.0</td>
<td>27.5</td>
</tr>
</tbody>
</table>

When silages are fed heavily DMI declines by 0.02% of body weight for each 1% decrease in total ration DM. Maximum DMI depends on continuous access to fresh, clean, cool water. Milch animals drink about 5 liters of water for each kg milk (e.g. a cow producing 40 liters of milk will consume 200 liters of water). Lactating animals are thirsty and hungry immediately after milking, decreasing water intake by 40% results in a 16 to 24% decline in DMI and a large decrease in milk yield. These animals need more water in hot weather. Dairy animals experience severe heat stress when temperature exceeds 28°C, when relative humidity exceeds 75% or when the two values added exceed 100. DMI may be depressed by 15 to 20% on hot summer days. Summer DMI improves when you offer at least 60% of the ration fed at cooler hours or during night.

**Fodder Intake**

Fodders or roughages are feeds high in fibre (e.g. Sorghum, Bajra, Oats, Berseem and Corn silage). The DMI from roughage determines the amount and type of the concentrate required in the ration. An economical feeding program is one based on high consumption of high quality roughages. Roughage intake depends on forage quality, size of the animal and concentrates levels. Milking bovines can consume 1.8 to 2.2% of body weight daily as DM from average quality dry roughage. Roughage quality is partly determined by fibre levels. Fibre content increases as the forage crop matures. High fibre forage has lower palatability, reduced protein levels, and is less digestible than high quality material. Undigested feed cannot pass out of the rumen. The milch animal cannot consume more feed until the feed in the rumen is digested. High fibre forages reduce DMI. An animal can eat 3% of body weight as DM from excellent silage but only 1.5% from poor one. The nutrient value of fodders depends on plant species, stage of maturity, and on harvesting and storage systems and losses.

Dairy animals should neither gain nor lose body condition during dry period. Daily concentrate allowance after dry off will depend on roughage quality. When roughage quality is poor, 2 to 4 kg of concentrate may be required daily to maintain body condition. If roughages are good, but animals are thin, 2 to 4 kg may still be required to allow for moderate and gradual weight gain during the dry period. Individualized feeding programs can be designed if dry cow and buffaloes are grouped by body condition and closeness to calving. A balanced dry ration should contain adequate fibre, protein, vitamins and minerals (Table 2).
Table 2: Guidelines for Composition of Complete Rations

<table>
<thead>
<tr>
<th>Levels of Milk Produced Per Day</th>
<th>&lt;20 kg</th>
<th>30 kg</th>
<th>40 kg</th>
<th>50 kg</th>
<th>Early Lactation 0-3 Weeks</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protein</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude protein %</td>
<td>12-15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>12</td>
</tr>
<tr>
<td>DIP, % of CP</td>
<td>63</td>
<td>61</td>
<td>60</td>
<td>55</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td>UIP, % of CP</td>
<td>37</td>
<td>39</td>
<td>40</td>
<td>45</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEI, Mcal/kg</td>
<td>1.42-1.52</td>
<td>1.62</td>
<td>1.72</td>
<td>1.72</td>
<td>1.67</td>
<td>1.25</td>
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<tr>
<td>TDN, % of DM</td>
<td>63 - 67</td>
<td>71</td>
<td>75</td>
<td>75</td>
<td>73</td>
<td>56</td>
</tr>
<tr>
<td><strong>Fibre</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude fibre, %</td>
<td>17</td>
<td>17</td>
<td>15</td>
<td>15</td>
<td>17</td>
<td>22</td>
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<td>ADF, %</td>
<td>21</td>
<td>21</td>
<td>19</td>
<td>19</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>NDF, %</td>
<td>28</td>
<td>28</td>
<td>25</td>
<td>25</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td><strong>Minerals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium, %</td>
<td>.43-.51</td>
<td>.58</td>
<td>.64</td>
<td>.66</td>
<td>.77</td>
<td>.39</td>
</tr>
<tr>
<td>Phosphorous, %</td>
<td>.28-.33</td>
<td>.37</td>
<td>.41</td>
<td>.41</td>
<td>.48</td>
<td>.24</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>.9</td>
<td>.9</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>.65</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>.2</td>
<td>.2</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
<td>.2</td>
</tr>
<tr>
<td>Sulphur, %</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.2</td>
<td>.16</td>
</tr>
<tr>
<td>Sodium, %</td>
<td>.18</td>
<td>.18</td>
<td>.18</td>
<td>.18</td>
<td>.18</td>
<td>.1</td>
</tr>
<tr>
<td>Chlorine, %</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
<td>.2</td>
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<tr>
<td>Manganese, ppm</td>
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<td>40</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Copper, ppm</td>
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<tr>
<td>Zinc, ppm</td>
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<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Iron, ppm</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Cobalt, ppm</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
<td>.1</td>
</tr>
<tr>
<td>Iodine, ppm</td>
<td>.6</td>
<td>.6</td>
<td>.6</td>
<td>.6</td>
<td>.6</td>
<td>.6</td>
</tr>
<tr>
<td><strong>Vitamins</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A, IU/kg</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
<td>3200</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>Vitamin D, IU/kg</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1200</td>
</tr>
<tr>
<td>Vitamin E, IU/kg</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

With proper challenge feeding, you can get freshly calved animals on full feed quickly. For the first few days after calving, don’t increase the feed drastically what was offered pre-calving. Feed high quality forage, including hay if possible. Offer several pails of lukewarm water to reduce the stress of calving. Keep the cow eating and the rumen full to prevent twisted stomachs and milk fever. About 3 to 4 days after calving, challenge feed your cows and encourages high peak yields by increasing the feed. Offer a high protein feed in addition to the major grain (energy) feed in early lactation. Start the protein supplement during the first few days of lactation, if not fed pre calving. Protein stimulates appetite and feed digestibility in the newly calved mother. Protein requirements in early lactation are high, at 19% of the diet DM (Table 2). At peak milk production the protein requirement is 18%. Try to get cows and buffaloes up to the maximum amount of the high protein feed by 2 weeks into lactation. Increase the feed gradually. Cows pushed too fast will go off-feed. Most cows can tolerate an increase of 1 kg every other day during the first week.

Dairy producers often overfeed low producers and underfeed high producing, early lactation animals. Underfeeding grain causes low milk production especially in early lactation, excessive body weight loss, lower conception rate, more herd health problems, less income (net returns) over feed costs. Overfeeding is most likely to occur in the later stages of lactation or the dry period. Overfeeding is
costly in terms of value of milk being produced, and may lead to overly fat milking animal. Fatty animals have more calving difficulties, reduced appetite after calving, and increased incidence of ketosis, twisted stomach and udder edema. They are also more susceptible to bacterial infections such as metritis and mastitis.

Protein in the diet

The amount & type of protein provided in the concentrate mixture is important. Feed protein contains two major protein fractions. Protein digested in the rumen by the microbial population; rumen degradable intake protein (DIP). Feeds high in DIP are haylage, raw soybeans, mustard cake and urea. About 55 to 65% of the total protein in the ration should be rumen degradable. Protein not digested by rumen microbes is undegradable intake protein (UIP). This is often called "bypass" or "escape" protein because it bypasses the rumen without being digested. Some plant source feeds high in UIP are roasted soybeans, corn distillers' grains, brewer’s grains and corn gluten meal. About 35 to 45% of the ration protein should be UIP. The 35% level is suitable for mid to late lactation cows. Fresh, high producing need 40 to 45% UIP in the ration DM.

Energy, Fibre & Fat in the rations

A lack of dietary energy causes to rely excessively on body reserves. Rapid body fat mobilization, along with low feed and/or energy intake, leads to ketosis (acetonemia). Animals losing weight are in negative energy balance. They show weaker heats and have lower conception rate than those gaining in condition and in positive energy balance. Most high producing cows, in early lactation are in a mild (subclinical) state of ketosis, which causes few problems except gradual body weight loss.

Corn is the least expensive grain. It is the highest energy grain containing high levels of starch. When rumen microbes digest starch, they produce acidic end products. Rumen acidity increases, reducing fibre digestion. This may lead to "off feed", a decline in milk yield and fat test depression. When grain levels are maximized, an alternative approach is to increase the energy level by adding by pass fat. It may be economical for early lactating or above 35 & 18 liters in cows & buffaloes respectively. Fat contains over 2.25 times the energy value of grain. Added fat improves energy balance by reducing body weight loss, improving persistence of production and assisting in an early return to positive energy balance.

Feeding Management

- Feed grain meals of less than 4 kg of grain per feeding
- Feed grain in several small meals daily rather than two large ones, especially in hot weather
- Feed protein supplement with the grain meal
- Feed a forage meal 1 to 1 1/2 hours before a grain meal
- Combine forages (Eg. haylage plus silage) or feed a TMR
- Have fresh feed available in bunks or mangers after milking time
- Adapt feeding strategies to the eating behavior of your animals
- Feed forages several times and TMR's at least twice daily
- Clean mangers and bunks daily especially in hot weather
- Clean water bowls and troughs frequently
- Provide at least 90 cm (3 feet) of bunk space per milking animals
- Allow access to feed for at least 22 hours of the day
- Healthy, contented cows & buffaloes eat more feed

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Globally, nanotechnology is an emerging and promising technology that has a challenging prospect of revolutionizing agriculture, especially in the livestock sector (Huang, et al., 2015). The idea of Nanotechnology was given first by Nobel laureate of physics Richard Feynman, in 1952. The term "nano" refers to one-millionth of a millimeter.

Modes of action of nanoparticles

Nanoparticles, smaller in size, have different mechanisms of action described as follows by Chen et al. (2006).

a) Nanoparticles that tend to increase the surface area for better interaction with biological support
b) Prolonged the compound residence time in gut
c) Reduce the influence of intestinal clearance mechanisms
d) Penetrate deep into tissues by fine capillaries
e) Cross epithelial lining fenestration
f) Enable cells for efficient uptake
g) Effective delivery of functional compounds to target sites and thereby better bioavailability

Nanoparticles are both inorganic and organic and have different applications in the livestock sector. Apart from these, nanoemulsions and nanaoclays are also found helpful in the livestock industry. The significant applications of nanotechnology concerning animal and poultry production are in administering nutrients, supplements, probiotics, and drugs, diagnosis and treatment of diseases, and using hormonal immune-sensors to manage reproduction.

Nanominerals in animal and poultry nutrition

However, the application of nanotechnology in animal/poultry feeding is mainly in the form of nano-minerals. This area is crucial as it increases trace minerals' absorption by reducing the antagonistic effect among the bi-valent cations. This novel strategy can be exploited in livestock and poultry nutrition for efficient uptake of nutrients for better utilization of feedstuff and other supplements.

Nano ZnO

Nano Zn being 3rd most widely produced nanomineral, has more bioavailability than organic and inorganic forms of ZnO. The studies have also revealed the role of nano ZnO in methane mitigation in ruminants. A study on nano zinc showed that supplementation of 0.06 ppm in the basal diet of broiler birds showed improved immune status and bioavailability compared to inorganic zinc. Moreover, different concentrations of ZnO-nano-particles also inhibit mycotoxic fungi growth of A. flavus, A. ochraceus and A. niger (Sahoo, et. al., 2014).

Selenium nanoparticles

Supplementation of nano selenium in the diet leads to selenium retention in the body and liver compared to sodium selenite. In bucks, dietary supplementation of nano-Se at the rate of 0.3 ppm showed an increased growth rate with improved testicular structure and semen quality (Guang et al., 2010).

Copper Nanoparticles

Copper from copper nanoparticle sources shows better growth performance and immunity than conventional copper sources with large particle sizes. Copper nanoparticles have antibacterial, antifungal and antiviral properties. In piglets,
supplementation of nano copper (Cu) at the rate of 50 ppm in diet had significant improved growth and other parameters. (Gonzales-Eguia, et.al., 2009).

**Calcium Nanoparticles**

Different sources of calcium like limestone and DCP are used in the diet of livestock but high concentration of limestone powder in the diet can decrease the calcium, phosphorus and amino acid digestibility because of the elevation of alkalinity in the intestine. Birds fed Nano DCP diets gained more body weight with reduced FCR than conventional DCP diets (Hassan, et. al., 2016).

**Risks and Hazards Related to Nanoparticles**

Naturally occurring nanominerals, which act as environmental pollutants, cause toxic effects on grazing animals near the industrial area. This toxicity can be assessed by several criteria like the toxicity of nanoparticles, exposure assessments, environmental and biological fate, recyclability and overall sustainability of nanomaterials. Growing scientific evidence indicates that insoluble nanoparticles may cross cellular barriers and reach new targets in the body. Also, exposure to insoluble/biopersistent nanoparticles via food may lead to specific adverse health effects.

**Conclusion**

The use of nanoparticles in poultry and animal production systems is growing in scale and scope. The use of nanotechnology in animals and poultry offer several beneficial effects viz., improved bioavailability of trace minerals, excellent antimicrobial activities against significant pathogens, improved gut health, and production of short-chain fatty acids. Pharmaceutical/nutritional supplement companies should enhance nanomineral’s manufacturing, packaging. The application of nanomaterials in animal production is gaining popularity, however it requires a detailed study of the residual effect of nanominerals on animal and human health.

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RECENT INITIATIVES IN ANIMAL HUSBANDRY AND DAIRY SECTOR

Srishtipriya Prasad¹, Mohit Bharadwaj², Ripusadan Kumar³, B.C.Mondal⁴, MVSc Scholar¹, Phd scholar², Assistant Professor³, Professor⁴

Introduction

The agriculture sector has experienced buoyant growth in the past two years. The sector, which is the largest employer of workforce, accounted for a sizeable 18.8 per cent (2021 22) in Gross Value Added (GVA) of the country registering a growth of 3.6 per cent in 2020-21 and 3.9 per cent in 2021-22. Growth in allied sectors including livestock, dairying and fisheries has been the major drivers of overall growth in the sector. The livestock sector has grown at a CAGR of 8.15 per cent over the last five years ending 2019-20. This improvement in the contribution of allied sectors is in line with the recommendations of the Committee on Doubling Farmers' Income which has suggested a greater focus on allied sectors to improve farmers' income.

National Animal Disease Control Programme

It is the largest ever vaccination programme carried out either for human or animal vaccination in the world, is being implemented with the aim to control and eventually eradicate the Foot & Mouth Disease (FMD) and Brucellosis by 2030. During 2021-22, the second phase of the vaccination commenced from July, 2021 and so far 5 crore animals have been vaccinated against FMD and 27.8 lakh animals vaccinated against brucellosis till December, 2021.

Animal Husbandry Infrastructure Development Fund (AHIDF)

As part of the ANB stimulus package, the Animal Husbandry Infrastructure Development Fund (AHIDF) worth Rs 15,000 crore was launched in 2020. AHIDF facilitates investments in the establishment of infrastructure for dairy and meat processing and establishment of animal feed plants by the FPOS, individual entrepreneur, MSME, Section 8 companies and private companies. Under this scheme the Central Government provides 3 percent interest subvention to the borrower and credit guarantee up to 25 per cent of total borrowing.

CONCLUSION

The performance of the agriculture and the allied sector has been resilient to the COVID 19 shock. The sector grew at 3.6 per cent in 2020-21 and improved to 3.9 per cent in 2021 22. Increasing importance of allied sectors including animal husbandry, dairying and fisheries in growth and income of the farmers indicates that focus needs to shift more towards harnessing the potential of allied activities.

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RECENT ADVANCES IN THE VACCINES OF FOOT AND MOUTH DISEASE

Sanjeev Ranjan and Anjay

Foot and mouth disease (FMD) is a highly contagious disease of cloven-hoofed animals including cattle, swine, sheep, goats, and deer, characterized by fever, lameness and vesicular lesions of the tongue, feet, snout and teats resulting in high morbidity but low mortality in adult animals. However, mortality can be high in young animals since the disease can cause myocarditis. FMD virus is the member of Aphthovirus genus of the family Picornaviridae (Rodrigo & Dopazo, 1995), exists in the forms of seven different serotypes namely A (Allemagne), O (Oise), C (Third serotypes), South African Territories types SAT-1, SAT-2 and SAT-3 and Asia-1 (from Pakistan, 1954). Majority of outbreaks in India are caused by type “O”, followed by Asia-1, A and C and estimated loss due to FMD in India is over 2250 crores (Mathew, 2008). Due to socio-economic religious reasons in India, slaughter of the affected animals is not possible. Thus vaccination is the only approach to control the disease.

Vaccines for FMD

Vallee and Carre, made the first experimental vaccine against FMD and Rinjard in 1925 using formaldehyde inactivated tongue tissue infected cattle (reviewed by Brown, 1999). Frenkel’s (1947) approach of using formalin killed FMDV produced in bovine tongue epithelial suspension as vaccine has marked the era of control of FMD by vaccination which is now replaced by mass production of virus in BHK 21 suspension cells and inactivation by formalin or Binary Ethyleneimine (BEI) and adjuvanted with either aluminum hydroxide gel and saponin for cattle or with montanide oil (Gomes et al., 1980) for swine and cattle.

Quality of immune response is poor for BEI inactivated viruses as compared to that for formalin inactivated one, probably due to stabilization of the antigenic structure by formaldehyde (Rowlands et al., 1975). Conventional vaccines against FMD such as tissue cultured inactivated vaccine has shown to provide good protection (Woolhouse et al., 1996) but vaccines have several limitations like, short duration of immunity, requirement of sophisticated facility leading to high cost of production and problem related to the handling of the virus in bulk. Moreover improper inactivation leading to vaccine related outbreaks as reported by King et al. (1981). However, with the advent of recombinant DNA and polypeptide synthesis technologies, several new approaches were made to overcome these limitations. Molecular studies with respect to FMDV were directed towards the development of better vaccines which hold promise in replacing conventional vaccines as efficient, economic and safe alternatives.

The VP1 protein expressed in E.coli was used as a candidate vaccine for cattle and swine. However, it gave poor immunity to the vaccinated animals (Suryanarayana et al. 1992). Foliar extracts infected with RNA transcripts from Tobacco Mosaic Virus (TMV) based vector carrying complete VP1 showed specific antibody response against VP1 as well as the complete virus and eliciting a protective response against experimental challenge with virulent FMDV in mice (Wigdorovitz et al., 1999). Early observation indicate that isolated VP1 and the fragments derived from its C-terminal half are the only viral capsid products capable of inducing neutralising antibodies and conferring partial protection (Meloen et al., 1986) immunisation with VP1 produced in bacteria conferred protection in the pig (Klied et al., 1981). However, the immunogenicity of such a VP1 was lower by several orders of magnitude than that of the equivalent amount of antigen incorporated in viral particles (Domingo et al., 1990) to use as a vaccine has been carried out. The vaccine based on cloned and expressed VP1 of serotype Asia1 (Suryanarayana et al., 1985) gave a partial protection (Suryanarayana et al., 1992).

It has been shown that empty capsid particles of
FMDV from gene cloning technology, retain the immunogenicity and antigenicity (Grubman et al., 1985) of infectious virus particles and that the immunogenicity is superior as the antibodies produced are not only against sequential epitopes but also against conformational epitopes and hence may represent an efficient and safe alternative vaccine candidate. Several host vector systems are available for the production of empty capsids. Bacterial system, insect (Lewis et al., 1991) and mammalian cell systems (Abrams et al., 1995) were tried for expressing P1 region of FMDV.

A. Synthetic peptide vaccine

The VP1 region of amino acids 21-40 contain T-cell epitopes and offers cross protection to serotype, the VP1 region of amino acids 141-156 protects homologous virus strains, and the region of amino acids 200-213 offers cross protection to homologous and heterologous viruses. Synthetic peptide corresponding to C-terminal region of VP1 (amino acids 147-160 and 200-213) that could elicit high neutralizing antibody response were tested as vaccines in guinea pigs (Strohmaier et al., 1982). Wang et al (2002) have suggested a safe chemically defined peptide containing the GH loop domain of VP1 and a novel promiscuous helper site for broad immunogenicity in multiple species as an advantageous vaccine against FMD.

B. DNA vaccines

Immunization with plasmid DNA elicits both cell-mediated and humoral immune responses (Yang et al., 2001). These responses include the generation of antigen-specific cytotoxic T lymphocytes (CTL) and protective neutralizing antibodies. In earlier studies, it was found that plasmid DNA construct could elicit CTL response that is always lacking in an immune response elicited by protein vaccines. Since CTLs are considered necessary for a successful defense against intracellular pathogens like viruses, this particular aspect of DNA vaccine is one of its great advantages over protein-based vaccines. In addition, it has also been found that the B-cell and T-helper (Th) cell responses are also elicited in DNA vaccination as antigen genes contained in the plasmids are translated and presented for surveillance (Tighe et al., 1998).

C. Molecular adjuvants

Cytokines produced by T helper cells play a pivotal role in the induction and regulation of cell-mediated and humoral immunity. Previous results in pigs have showed that systemic levels of IL-6, IL-8 and IL-12 increased following vaccination (Barnett et al., 2002). Particular vaccines can drive the immune response toward either Th1 or Th2 type responses and such responses are typically associated with a particular set of cytokines.

Cadillo-Barron et al. (2001) have reported an enhancement of immune response by co-inoculation of a GM-CSF construct and a FMDV P1-2A3CD construct. Wong et al. 2002 have reported a similar enhancement by employing swine interleukine-2 (IL-2) as a gene adjuvant. Although protection against FMDV correlates in general with neutralising antibodies, a T-cell response is essential for effective immunity and ultimate elimination of carrier status in convalescing animals. IFN-γ has been reported as a potent antiviral cytokine stimulating strong T-cell responses and replication of FMDV in infected bovine cell. The induction of monocyct cell activity, demonstrable by the production of IL-6, IL-8 and IL-12, appears to play a critical role in FMDV emergency vaccine induction of innate immune defense, which relates to early protection against FMD. A pig inoculated with replication-defective human adenovirus type 5 vectors containing IFN and FMDV genes was completely protected when challenged 24 hrs later with FMDV. Cadillo-Barron et al (2003) have investigated the immune response in pigs to two recombinant plasmids co-expressing immunodominant neutralizing antibody epitope of FMDV VP1 protein (serving as a source of T-cell epitopes of in induction of immunity) and viral non-structural proteins.

Even after a century of discovery, FMD is persisting as a global menace and causes huge losses to farmers. Many international regulations have been designed which impose embargo on import of animals, their meat and milk products from endemic country to minimize the risk of disease introduction into FMD free countries. Due to the existence of several serotypes, various vaccines are used, at present, to confer protection. However, the existence of carrier animals poses a constant threat of fresh outbreaks. Consequently, elimination of these carriers constitutes an important element in any endeavour to stamp out the disease. Exhaustive vaccination and proper monitoring of animals can helps in elimination of FMD from the country.

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The animal agriculture sector in particular provides human food, employment (18.8% of the Indian population) and livelihood in two-thirds of small and marginal farmers in the rural India. India is the world’s largest milk producer, third largest egg producer and sixth largest poultry meat producer. The development of poultry sector in India is a classic example of the growing potential of animal husbandry to meet the protein in the diet of a growing human population. But, scarcity of fodder, non-availability of grazing land, decrease in number of livestock owners especially in rural areas, and reduced animal performance due to climate changes such as heat stress are some of the challenges which direct the changes in the animal agriculture system of India. There is a need to adopt smart farming strategies to minimize the undesirable effects of climate change on animal health and production, which include adequate housing conditions, efforts to reduce body heat, optimal nutrition with added supplements, rotational grazing, silvopasture, intensification of pasture production, availability of an adequate quantity of quality water and selection of thermostolerant animals. In this regard, the advantages of the use of native breeds under the prevailing hot and fluctuating environmental conditions are being focused on. Thus, conservation of indigenous breeds is one of the major focuses in the recent animal agriculture system. Assisted Reproductive Techniques such as the use of sex-sorted semen for artificial insemination will limit the male cattle population and increases the milk production. Technologies available at farmers’ doorstep are being developed, and one such is the early prognosis diagnosis kit (Preg-D) developed by ICAR-CIRB, Hisar to identify the pregnancy in cows and buffalos at 30 days after insemination. Value-added milk and meat products are becoming more popular now a days and attract more consumers. Goats are usually reared for meat and there is rising demand of goat meat in the market. Thus, a focus on sustainable goat production with native thermostolerant breeds may attract the farmers while also benefitting them through an effective cost-benefit ratio. There is the use of advanced biotechnological tools and technologies to improve animal health and welfare with the aim of identifying superior germplasm and conserving our native breeds. Thus, modern animal agriculture in India focuses on sustainable animal production with the existing climatic conditions, conservation and validation of native breeds over exotic and cross-bred animals in terms of disease tolerance and enhanced production with an improved cost-benefit ratio.

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