Refresher Training Programme

on

"Management of Modern Dairies Under Agri-Clinics and Agri-Business Centers Scheme"

August 23-25, 2023

Organized by:

MANAGE, Hyderabad

&

Dr Harry Dairy & Allied Consultancy Services

Karnal-132001 (Haryana)

www.dairyconsultants.co.in

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Course Directors

Dr. Shahaji Phand
Principal Coordinator
(AC&ABC)

Mr. Mahesh Mane
Coordinator
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Published by:

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Dr. Shahaji Phand

Dr. Shahaji Phand, Deputy Director and Centre Head of Centre for Extension in Agri-allied Sector and also Principal Coordinator, Agri-Clinics and Agribusiness Scheme (AC&ABC), National Institute of Agricultural Extension Management (MANAGE), Hyderabad. He is veterinary graduate and completed Bachelor of Veterinary Science and Animal Husbandry (B. V. Sc. A.H) degree in 2002 from Maharashtra Animal and Fishery Science University, Nagpur Maharashtra. He completed his Master and Doctoral Degree in Veterinary Extension Education from Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh in 2005 and 2008 with Junior and Senior Research Fellowship respectively. After completion of doctoral degree, he joined as Assistant Professor in Nanaji Deshmukh Veterinary Science University (NDVSU) in June 2008, promoted as Associate Professor in 2012 in same university. After serving 8 years as faculty in university, he joined as Assistant Director in MANAGE, Hyderabad in 2016 and promoted to post of Deputy Director in 2018. He has developed 02 technologies in the form of computer software's namely Animal Health Information System (AHIS) and Health Information System for Dairy Animal (HIS) as part his doctoral research, which is patented and commercialized. For this contribution he has been conferred with Dr. C.M. Singh Award for Best Ph. D Research at national level. He has published more than 30 research and review papers in national and international journal and edited of more than 27 books. He has been editor, reviewer and member of editorial board of national and international Journals. He has organized and coordinated more than 300 training programs for senior and middle level officers of State Department of Agriculture and Allied sector, Scientist, SAU faculties, Students etc. which benefit reached more than 4000 stakeholders. He has organized and participated national level conferences, seminar, workshop and contributed for policy formulation. As a Principal Coordinator, he is implementing Agri-Clinics and Agribusiness Scheme (AC&ABC) with the help of 126 Nodal Training Institute (NTIs) across the country, which have trained more than 7500 agricultural graduates and diploma holder, among which more than 3000 trained candidates have established their agri-venture in last two years and serving farming community.

Mahesh N. Mane

Education:

- Master's in Agriculture and Food Business Management

Career Objective:

- To contribute passionately to a professional organization with a focus on agriculture and food business development.

Core Expertise:

- Technical: Proficient in Agricultural Production Practices, Planning, and Monitoring; Value Chain Establishment for Agricultural Commodities; Resource Mobilization; Application of New Agricultural Technologies; Agriculture Marketing; Supply Chain Management.
- Managerial: Skilled in Agriculture Management, Marketing, and Post-Harvest Management.

Skill Set:

- Communication
- Leadership
- Networking
- Report Writing
- Documentation
- Problem Solving

Professional Experience:

1. **Consultant - National Institute of Agricultural Extension Management (MANAGE)**
    - Currently working as a Consultant since July 2016.
    - Consulting for the Agri Clinic & Agri Business Scheme in Maharashtra.
2. **Agriculture Marketing Expert - Maharashtra Agricultural Competitiveness Project (MACP)**
    - Worked from July 2014 to July 2016.
    - Led Strategic Research and Extension Plan preparation.
    - Coordinated MACP project implementation.
    - Trained extension machinery for agriculture-related marketing.
    - Collaborated with Agricultural Business Promotion Facility for entrepreneurship training.
3. **District Project Facilitator - Maharashtra Water Sector Improvement Project (MWSIP)**
    - Worked from January 2012 to June 2014.
    - Coordinated multi-sector planning for land and water resources.
    - Improved irrigation services and agriculture productivity.

- Promoted agro-entrepreneurship and water management skills.
- Fostered NGO and private agency partnerships for development.

4. **Marketing cum Technical Executive - K. F. Bio-plants Pvt. Ltd**
    - Worked from November 2011 to January 2012.
    - Managed greenhouse projects, marketed seedlings, and provided technical support.
    - Organized farmer meetings, demonstrations, and promotional activities.
    - Established dealer networks and value chain marketing.
5. **Project in Charge - Samruddha Jeevan Foods India Ltd**
    - Worked from April 2010 to June 2011.
    - Managed agricultural projects, promoted contract farming, and handled HR.
6. **Rural Agriculture Work Experience - Krishidut**
    - Implemented new farming technologies with host farmer.
    - Conducted awareness programs, method demonstrations, and Kisan Fairs.

Special Training:

- Received training in SAP, ISO 22000, Modified Atmospheric Packaging, Grafting, Agri-clinics and Agri-business Centers scheme, Agriculture Marketing, and more.

Programs Broadcasted on Radio:

- Presented programs on strengthening Agriculture Price Marketing Committee (APMC) and alternative markets for farmers on "Akashwani" Radio.

Additional Info:

- Proficient in various aspects of agriculture management, marketing, and technical practices.
- Actively engaged in project implementation, training, and capacity-building across different agricultural projects and initiatives.

DR. HARI RAM GUPTA

Founder,

DR HARRY DAIRY & ALLIED CONSULTANCY SERVICES

B. Tech (Dairy Technology), M.Tech (Dairy Technology), NDRI-Karnal,
PhD. (Dairy Science Technology), IGNOU- DELHI
#10, Shakti Colony, Mall Road, Karnal, 132001(Haryana)
+91 93541-20651, +91 7470000340; hrgndri@gmail.com

Dr. Hari Ram Gupta has been serving ICAR-NDRI for last more than three decades and contributing hugely for institutional development and dairy development. Dr. Gupta has demonstrated outstanding leadership attributes while leading experimental dairy staff of NDRI Karnal and as Programme Coordinator of an external funded project Business Planning & Development (BPD) Unit, NDRI, Karnal.

Dr. Hari Ram possesses excellent technical skills which were demonstrated at times. He was instrumental in "Low Cholesterol Ghee" making process and transfer of technology to the dairy sector, Bihar project for establishment of new Institute of NDRI regional centre, providing guidance for the project of making A1 cow milk powder in Experimental Dairy. Dr. Gupta has successfully developed technologies for Cocoa and Whey Protein Enriched Functional Dairy Drink; Whey Protein fortified products like Whey Protein Khoya Burfi, Whey Protein Lassi, Whey Protein Flavoured Milk, Whey Protein Tilla Kulfi and Whey Protein Bar.

Dr. Gupta was a resource person for conducting practical classes of KVK & BPD unit entrepreneur trainees. He has trained number of UG/PG students from various dairy and food science colleges across India and delivered numerous lectures on "Preparation of Flavoured Milk and Lassi" 'Milk Processing & Manufacture of Selected Dairy Products' "Fat/SNF standardization of milk using Pearson Method" "Technology of Fat Rich Dairy Products" milk and milk product manufacturing.

He has published 19 research Papers (national & international); 18 Technical / Popular articles in reputed periodicals and 2 book chapters. He has also published a book "**Whey Protein & Cocoa Enriched Functional Beverages"** by LAP LAMBERT Academic Publishing, Germany.

To further enhance and update his skills he has attended training on Technological Aspects of Composite Dairy Foods; Advances in Technology, Quality and Safety of Functional Dairy Foods; and Engineering interventions in processing and value addition of milk and milk products. He is also a certified Lead Auditor for ISO 22000, Food Safety Management System. He had attended 4 International and 7 National seminars on dairy and food.

Dr. Gupta is life member of Indian Dairy Association, Dairy Technology Society of India, and NDRI Graduates Association.

Dr. Gupta has been actively involved in number of institutional building activities by acting as member of the Employees Welfare Fund Committee, Chairman of the several departmental Committees, and member in interview committees. Dr. Gupta is also actively involved in various social welfare activities at the village as well as city level.

Dr. Gupta has received many awards namely Best Research Paper Certificate by "International Journal of Business Management & Research"; Second Best Research Paper in the category of "Economics and Extension" and "Dairy Processing" by Indian Journal of Dairy Science.

Dr. Gupta also has been awarded the "**Unnat Bharat Sewashri Ratan"** in 2017 and "**Lifetime Achievement Award**" in 2018 for contribution in dairy field by Rashtriya Patarkar Sangadhan and Rashtriya Kissan Sangadhan at Constitution Club, New Delhi.

Post retirement, Dr. Gupta utilized his skills and expertise to contribute to the industry and with nutritional and functional foods keeping in view the nutritional security of the youth. In line with this objective Dr. Gupta entered as a start-up entrepreneur into the value-added product category. Currently Dr. Gupta has two registered startups named DR HARRY DAIRY & ALLIED CONSULTANCY SERVICES and DR HARRY NUTRITION INTERNATIONAL HEALTHCARE being operated from the office based at #10, Shakti Colony, Mall Road, Karnal. In research and development, he has developed Whey Based Beverages and participated in 'Agri-startup Incubation programme' organized by (AFBIC), IIT Kharagpur and selected as innovative product and finally he is a Incubate of RKVY-RAFTAAR scheme of Ministry of Agriculture & Farmer 'Welfare, Govt. of India (IIT Kharagpur) and funded by. The companies mainly deal with:

- A complete solution for dairy and allied consultancy services
- Training for milk processing and milk production
- Sale/Purchase of farm animal
- Testing milk for fat & adulteration
- Setting of milk processing plant
- R&D for new dairy products

Over the last four years the above companies have progressed significantly despite the COVID – 19 era for two years. The progress report charts are shown below which itself are self-explanatory. The targeted revenue for the current financial year (2023 – 2024) is expected to cross 1.00 Crores.

Refresher Training Programme

"Management of Modern Dairies Under Agri-Clinics and Agri-Business Centers Scheme" Programme (AC& ABC),

National Institute of Agricultural Extension Management (MANAGE) – Hyderabad

Programme Schedule: August 23-25, 2023

Venue: Dr Harry Dairy & Allied Consultancy Services, Karnal-132001 (Haryana)

Time	Topic	Resource Person
Day-1 : 23/08/2023 (Wednesday)		
09:00 AM	Registration	
10:00 AM	Inauguration and AC&ABC Overview	MANAGE and Dr Harry Dairy & Allied Consultancy Services, Karnal
11:00 AM	Recent developments of economically feasible technologies in dairying.	Dr. S S Lathwal, PS & Incharge, Livestock Research Centre, NDRI
12:00 AM	Fodder production practices for round the Year Feed Security of dairy animals	Mr. Mohar Singh, Ex CTO, NDRI
02:00 PM	Major reproductive problems of dairy animals & practices for improved reproductive efficiency	Dr. KPS Tomar, Ex CTO, NDRI
03:30 PM	Marketing strategies of Milk	Mr. Ashok Kumar Rao, Dairy Consultant
05:30 PM	Feedback Session	Faculty
Day -2 : 24/08/2023 (Thursday)		
10:00 AM	Introduction to basic animal nutrition and importance of minerals & vitamin in dairy animals	Dr. P S Oberoi, Ex PS, NDRI
11:00 AM	Computer simulative modeling in dairy farming	Dr. P S Oberoi, Ex PS, NDRI
12.00 PM	Innovative ration and feed (concentrate) formulation	Dr. P S Oberoi, Ex PS, NDRI
02:00 PM	Common diseases of dairy animals: their symptoms, control and preventive measures	Dr. Satya Pal, Ex CTO, NDRI
03:00 PM	Management of dairy animals (birth to calving)	Dr. Brij Kishore, Ex TO, NDRI
04:00 PM	Applied aspect of dairy animals physiology and stress management	Dr. Mahinder Singh, ICAR-Emeritus Professor & Ex. HOD, AP Div., NDRI
5.00 PM	Clean Milk Production from Dairy animals	Mr. Ashok Kumar Rao, Dairy Consultant
05:50 PM	Feedback Session	Faculty
Day-3: 25/08/2023 (Friday)		
10:00 AM	Visit to a NDRI Cattle farm and Experimental Dairy	Dr. S S Lathwal, PS & Incharge, Livestock Research Centre, NDRI
12:00 PM	Dairy Farm Management (Shelter, Animal herd Management & Waste Management)	Dr. S S Lathwal, PS & Incharge, Livestock Research Centre, NDRI
02:00 PM	Importance of breeding bulls and Semen handling in organized dairy farms: An Overview	Dr. Brij Kishore, Ex TO, NDRI
03:30 PM	Summary and Feedback	Faculty
04:00 PM	Valedictory Function	Faculty
Dr Harry Dairy & Allied Consultancy Services	**Course Organizer** **Course Director** Course Coordinator	Dr. Shahaji Sambhaji Phand, balraje.shahaji@manage.gov.in Mr. Mahesh Mane, Consultant, 7972156528, mahesh.mane@manage.gov.in Dr. H R Gupta,07470000340, drharryconsultants@gmail.com
Timing: 10:00 AM to 5:30 PM (Lunch Break at 01:00- 02:00PM)		

CONTENTS

Economically Feasible Technologies in Dairy Farming

Dr. S.S. Lathwal, Principal Scientist & I/c LRC, NDRI Karnal

Today, dairy farmers focus more on precision farming by monitoring and developing a database for information provisioning and capturing competitive market data. To ensure sustainability and remain competitive in the market, dairy farmers need to monitor variety of data sources like cattle feeding, calving, nutrition, insemination, and the process of milk production. However, they also face several challenges such as:

Breeding infrastructure and genetics: The success of dairy farming is mostly attributed to the rising number of animals, and not productivity. When the resources are limited, it is imperative to increase the productivity per animal. There is a high demand for good animal genetics, breeding infrastructure and advance breeding methods such as artificial insemination and embryo transfer.

Animal feed and fodder: There is an acute and ever-growing shortage of green fodder and good quality feed. The growing trend of high breed animals is creating a huge demand for good quality feed and fodder to cater the dietary requirement of milking animals. Also, in order to avoid many health and nutrition related complications; prophylactic approach is driving the use of feed pre-mixes.

Animal health: Good healthcare and animal disease diagnostic solutions are required to address the gap. As high yielding animals demand extra care, the focus on animal health is driving this segment.

Farm mechanization: There is growing shortage and high cost of labor. Hence, farmers are adopting mechanization techniques to meet the global milk production.

Quality testing infrastructure and trained work force: Adequate quality testing infrastructure is not available at milk collection centers. The problem is compounded by the lack of trained manpower to undertake quality testing. At the consumer end, the demand for safe food is emerging fast and thus creates high opportunity.

Waste handling: The environmental challenges of dairy farms are related to disposal of dung and urinal wastewater. Poor handling and disposal of dung and wastewater cause water pollution and odor problems.

Today, Internet of Things (IoT) is making a significant impact on milk production. Global milk production to meet the demands of the growing population needs to be enhanced with technology. With this technology, farmers can enhance and improve several dairy related activities such as ascertaining the right time to milk cows, increasing the shelf life of the milk and so on.

In dairy farming, the Internet of Things (IoT) plays a crucial in the monitoring of resources by connecting multiple and heterogeneous objects in mixed dairy farms (which produce milk from cattle and cultivate feed grain for livestock), such as buildings, machinery and vehicles or even living organisms like cattle. The IoT Sensor and Edge Computing (EC) enable resource monitoring and traceability in the value chain, allowing producers to optimize processes, provide the origin of the produce and guarantee its quality to consumers.

The technological adoption of IoT and AI based approach helps in creating innovative methodologies for production (milk yield) and the process of dairy farming. Process innovation can be different for different sets of activities that are performed at several levels in a smart dairy farm. In a dairy farm, the milking process is viewed as a singular process; however, there are several activities that are performed in the farm such as feeding, cow monitoring, and preserving milk. The intervention of IoT can be in different processes and procedures like the feed system to sense the hunger needs of the cows and automatically feed them. It can also proactively monitor automatic heat detection that will assist in reproduction. Assessing health and monitoring cows for disease detection and prevention will help the farmer to locate any animal that needs medical attention.

Smart dairy farming includes real time sensors that collect data from cows with the help of wearable smart collars, machine learning data analysis, and cloud-based data centers that manage data and support the farmer in order to manage quality of dairy products.

IoT and AI technology adoption can play a significant role in the dairy industry to simplify the operations for milk producers and meet the increasing demand for quality dairy products. The technological advancement in IoT can help minimize environmental issues, decrease the use of resources, and enhance animal health by using advanced

sensing and data analyzing technologies. IoT based technology can be used in farm management to reduce costs and make operations efficient. Here are some key outcomes. Health monitoring: Monitoring and tracking of cattle health data like heart rate and other vital signs of a cow can help farmers in early diagnosis of health issues and provide correct medication.

Monitoring of anomalies in milk production:

It is essential to understand cattle behavior and milk production by monitoring continuously and comparing the regular patterns. Each animal can be tagged with a unique identification number to help track the animal's production and understand their health patterns. Tracking of automatic water and food supply: Water is an important nutrient for all animals, and it is important that cows should have sufficient quality water. Milk contains almost 87% water. The water requirements are closely related to milk production, the moisture content of the feed, and environmental factors such as air temperature and humidity.

Technology driven future for the dairy industry

New-age smart techniques using IoT devices will help farmers with increased milk production, advanced monitoring of cattle health & anomaly detection, thereby streamlining the business and processes. Although smart dairy farming using IoT gives various features to a common farmer, it may be a costly affair at the beginning; yet offers the promise of cost recovery with longer usage. IoT helps in efficient monitoring of the feeding and drinking method which can lead to better nutrition of cows, and more milk production. The system with overall architecture, better adaptation of technology, and versatile design can make IoT-based farming more efficient.

Fodder Production Practices for Round the Year Feed Security of Dairy Animals

Mohar Singh, Ex- Chief Technical Officer, ICAR- NDRI, Karnal

The health and productivity of livestock are closely linked with quantum and quality of forage production. The present fodder crop area could not be increased due to increasing pressure on cultivated land for food and commercial crop. The sustainability of dairy industry in India largely depend on the quality herbage based animal feed and fodder. To produce the targeted quantity of green fodder the best option is to maximize the fodder production per unit area and per unit time. To ensure the availability of quality fodder as per requirement throughout the year there is need to incorporate suitable fodder crops in the cropping system. An ideal fodder system is that which gives the maximum out term of digestible nutrients or maximum livestock products from a unit area. It should also ensure the availability of succulent palatable and nutritive fodder throughout the year. Green fodder is the essential component of feeding high yielding of milch animals to obtain desired level of milk production

One of the main reason for slow pickup of forage production is non- availability of good quality fodder seed varieties. With development of a number of improved and highly yielding varieties in forages, it has become that quality seed is readily available for supply to the farmers.

Quality forage seed in adequate quantities is the key to increase fodder production.

1. Crop : Berseem – Sowing Time – Last week of September to 2nd week of October is the best time for sowing

Seed Rate : 8 - 10 Kg per acre

S. N.	Varieties	Year of Release	Av. Fodder yield Qu/acre	Name of Institute Responsible for Development	Area of adoption	Main Characteristics of variety
1.	Mescavi	1975	320	C.C.S.H.A.U. Hisar	Entire Berseem growing area of country	Plants are shurby and erect growing up to height of 45 -75 cm. with profuse tillars. Stem is soft and succulent. It is tolerant to low and high temperature.
2	B.L-10	1983	410	P.A.U. Ludhiana	Entire Berseem growing area of country	It is a longer duration variety and supplies green fodder up to mid of June. It is moderately tolerant to stem rot disease. Its nutritive value and voluntary intake are high. Its seed crop mature in the last week of June.

3	B.L-42	2003	440	P.A.U. Ludhiana	Suitable for north west zone	It is quick growing variety which produces more number of tillers per unit area. It is tolerant to stem rot disease. It has superior nutritional quality it supply green fodder up to first week of June.
4	H.B-1 (Hisar Berseem)	2006	350	C.C.S.H.A.U. Hisar	Suitable for U.P, Haryana & Hilly Area	It is a quick growing; more number of tillers & superior nutritional quality it supply green fodder up to end of May. It is tolerant to stem rot disease.
5.	Bundel Berseem -2 (J.H.B-146)	1997	400	ICAR-IGFRI, Jhansi	Suitable for north west zone and central zone area of country	The plant high ranges from 55-65 cm. It has dark green leaves. The crop is fairly tolerant to acidic soil condition and is fertilizer responsive and resistant to root rot & Stem rot disease.

6	IGFRI S-99-1		350	ICAR-IGFRI, Jhansi	Entire Berseem growing area of country	It tolerant to low temperature. It has more number of tillers and leaves.
7.	U.P.B- 110	1993	300	G.B.P.U.A & T, Pant Nagar	Suitable for South Zone	It has prolific crown branching with succulent thick Stem. The basal shoots and side branches develop freely after cutting. It is long duration variety tolerant to Stem rot disease.
8	B.L-44	2021	395	P.A.U, Ludhiana	Suitable for Punjab & Haryana	It is quick growing variety with more number of tillers. It is moderately resistant to stem rot disease. It has superior nutritional quality. It supplies green fodder up to 1st week of June.
9	Pusa Giant	1975	370	ICAR-IARI, New Delhi	Entire Berseem growing area of country	It has dark green broader and thicker leaves and juicy stem. It yield about 10- 15% more then mesavi variety and tolerant to frost and low

						temperature
2. Crop : Lucerne – Sowing Time – Middle of October to Middle of November Seed Rate : 6 - 8Kg per acre						
1	Sirsa Type-9	1978	240-365	Fodder research station Sirsa.	Suitable for northern India where cold temperature prevails	This is a perennial Lucerne variety. The plants are vigorous, quick growing, slander stalk, foliage dark green leaves, and flowers bluish purple.
2	Anand -2	1984	325-400	G.A.U. Anand (Gujrat)	Suitable for Gujrat, Rajasthan, M.P. lucern growing area.	It has broad dark green leaves, deep root system and perennial variety. It gives 10-12 fodder cutting in a year.
3	L.L.C-5	1982	280	P.A.U Ludhiana	Suitable for Punjab & Haryana	It is a tall, erect and fast growing annual variety. It has broad dark green leaves with purple followers. It is highly resistant to downy mildew disease. Its gives eight cutting up to 1st week of July.

4	Anand -3	1995	300	A.A.U. Anand (Gujrat)	Suitable for cold dry zone of Himachal Pradesh	It is an annual type variety suitable for cold dry zone of Himachal Pradesh.
5	Co-1	1980	325-365	T.N.A.U, Tamil Nadu	Suitable for Tamil Nadu and Karnatka	It has high crude protein (20%) This is a perennial variety which can be maintained successfully for 3 years.
6	RL88 (Rahuri lucern)	1991	300-400	M.P.K.V.V. Rahuri Maharsthra	Suitable for entire lucern growing area	This variety has recommended for cultivation for year around irrigated situation in all zone of the country. It gives 11 cutting in a year. The variety resistant to major disease and pests.
3. Crop : Oats – Sowing Time – 2nd week of October to Middle of November Seed Rate : 35 - 40Kg per acre						
1	Kent	1975	210	-	Entire oats growing area of country	It is medium late and erect type with long droopy leaves. Av. Plant height

						at 50% flowering is 75-80cm. It is resistant to rust, blight and lodging. It has more number of tillers. First cut can be taken in 60 -65 days of sowing it gives two cutting in a year.
2	HJ-8	1997	260	C.C.S.H.A.U. Hisar	Suitable for Haryana.	It has fast growth, better regeneration and suitable for two cutting. It has broad green leaves.
3	U.P.O-212	1990	230	G.B.P.U.A & T, Pant Nagar	Entire oats growing area of country.	It is a multi cut variety. This variety has light green stem with 8-10 tillers. It gives 2-3 cutting.
4	Bundel Jai-851	1998	200	ICAR-IGFRI, Jhansi	Suitable for north and north west zone and entire oats growing area.	This is a multi cut variety having fast regeneration high leafiness, more tillering and high protein content. It can give up to 4 cuts. It has prostrate growth habit but become erect after tillering.

5	OL-10	2014	275	P.A.U .Ludhiana	Suitable for Punjab, Haryana and U.P.	It is a multi cut variety recommended for irrigated area. Its plant is tall profuse tillering and leafy growth. The leaves are long broader. Its fodder quality is superior in terms for TDN (Total Digestible Nutrients) and DCP (Digestible crude protein)
6	O.L-14	2020	307	P.A.U .Ludhiana	Suitable for Punjab, Haryana and U.P.	It is multi cut variety. Its plants are tall with profuse tillering and leafy growth. The leaves are long broader. Its fodder quality is superior in terms for TDN and DCP its seed yield is 10.9 quintal per acre
7	O.L-15	2021	320	P.A.U .Ludhiana	Suitable for Punjab, Haryana.	It Is a single cut variety. Its plants are tall having long and broad leaves with more leafiness and tillering ability. Its fodder quality is superior its seed yield about 9.8 quintal per acre

4. **Crop Maize** – Sowing Time – 1st week of March to middle of September. Seed Rate : 30 Kg per acre						
1.	African tall	1981	225	Mahatma Phule Agricultural University, Kolharpur (MR)	Entire Country	It has more number of leaves more leaf area. The variety is resistant to foliar diseases and stem borer. The av. Plant height is 260cm and the fodder quality is superior.
2	J-1006	1993	165	P.A.U .Ludhiana	Entire Country	Its plants are tall, vigorous and broad leaves. Its moderately resistant to maydis leaf blight and brown stripe downy mildew disease and stem broader and lodging resistant.
3	J-1007	2020	168	P.A.U .Ludhiana	Entire Country	The plants of this variety are tall with broad leaves. Its moderately resistant to maydis leaf blight and Charcoal rot disease.

4	APFM-8	1997	140	A.N.G.R.A.U, Hydrabad	Suitable for south zone of the country	It is a leafy, non lodging, orange grain variety, and plant height 180 to 200 cm sturdy plant type with dark green leaves.
5	Pratap Makka Chari -6	2008	150	M.P.U.A &T , Udaypur	North west zone of the country	It is a medium tall variety. Its stem is strong, medium thick and lodging resistant.
5. Crop : Sorghum – Sowing Time – 20 March to 10 April (in summer) , 25th June to 10 July (Rainy Session), April end - May end (Multi Cut Variety) Seed Rate : Single Cut Verity 20-25 Kg per acre Multi cut Variety 12-15 Kg. Per Acre						
a) Multi Cut Varieties						
1	SSG 59-3	1977	300	C.C.S.H.A.U. Hisar	Suitable for all sorghum growing area in north zone of the country	The Variety is tall and profuse tillering with quick growth. It is tolerant to drought and water logging. The Stem is sweet and thin. The first of the crop can be taken in 55-60 days of sowing and then after cut can

						be taken 35-40 day.
2	Hara Sona - 855	1994	300	Pro agro seed company ltd. Aurangabad	Suitable for cultivation in A.P., Gujrat , Haryana, Punjab, M.P. & U.P area	It is high tillering, thin stem, more leafy. Dark green color and superior fodder quality in terms and DCP and TDN and low HCN content.
3	Punjab Sudax chari-1	1994	480	P.A.U .Ludhiana	Suitable for Punjab, Haryana.	It is multicut variety. Its plant are tall with broad leaves, stem is juicy and sweet. it is resistant to red leaf spot diseases. The timely sown crop gives three good cutting during the summer session.
4	Punjab Sudax chari-4	2015	445	P.A.U .Ludhiana	Suitable for Punjab, Haryana.	It is multicut variety. Its plant are tall with broad leaves and ready for first cutting after 60 days of sowing. It is moderately resistant to leaf spot disease and shoot fly. The timely sown crop gives three good cutting.

5	CSH-24 MF	2019	365	G.B.P.U.A & T, Pant Nagar	Suitable for all sorghum growing area	This is the best multicut forage sorghum with good palatability, fast growth with excellent re-growth, high protein, and high digestibility. Its plant are tall with broad green leaves and ready for first cutting after 60-65 days of sowing and subsequent cutting after every 45 days. Fodder quality of this variety superior juicy, sweetness, soft and more nutritional quality and low HCN content. Plants are stay green up to maturity. This variety tolerant to water stress and water logging condition.
6	Pusa Chari - 109	2005	300	ICAR-IARI, New Delhi	Suitable for north zone of country	It is a multicut hybrid. Its plants are 225 cm. tall, semi erect, stay green type leafy with juicy stem. Its leaves are long broad with dull green midrib.

						This variety is tolerant to major foliar disease, shoot fly and stem borer.
b) Single Cut Varieties						
1.	H.C-136 (Haryana Chari)	1982	200-240	C.C.S.H.A.U. Hisar	Entire country	Its plants are tall, growing with long broad leaves. It is tolerant to foliar disease. It has low HCN content. Plants are stay green type. The variety is juicy, sweet broad leaves, stay green long time and superior fodder quality.
2	H.C-308	1996	215	C.C.S.H.A.U. Hisar	Suitable for all sorghum growing area of country	Its plants are tall, sweet, juicy and long broad leaves. Resistant to foliar disease, stay green upto maturity. Good crude protein and low HCN content.
3	Pant Chari-4	1997	185-215	G.B.P.U.A & T, Pant Nagar	Recommend for cultivation in U.P. except hill area.	Its plants are tall 350cm, purple pigmented with dark green leaves.

4	H.J-513	2007	225	C.C.S.H.A.U. Hisar	Suitable for north west zone of country	The plants are tall 245-260 cm. Long leaves and semi compact. Tolerant to major foliar diseases. Suitable for early and late sown condition in the Kharif Session.
5	H.J-541	2014	225	C.C.S.H.A.U. Hisar	Suitable for Haryana State	Its plants are juicy, sweet, better nutritional quality and stay green upto maturity. Resistant to Stem borer and having low HCN Content. High digestibility and crude protein content.
6	C.S.V.32F	2016	205	ICAR-IIMR, Rahuri Center	All sorghum growing area of Maharashtra, Tamil Nadu & Karnatka	Plants are more sweet, juicy and soft, height upto 12 ft. More protein and Low HCN Content. Stay green upto maturity and superior nutritional quality.

6. Crop : Bajra (Pearl Millet) – Sowing Time – March- April (Irrigated area) June- July (Rain fed area) Seed Rate : 4-5 Kg per acre						
1.	FBC-16	2003	230	P.A.U .Ludhiana	Suitable for north west zone of India	This is multicut composite variety It flowering 8-10 days letter as compared to other verities. Provide green fodder for longer duration. Plants attain an average height of about 235cm and have long broad leaves which remain green at maturity. Contain low amount of oxalates.
2.	Proagro-1 (FMH-3)	1998	300	Pro agro seed company ltd. Hydrabad	Suitable for all bajra growing area of country	This is a multicut variety. The plants required 50-55 days for flowering and mature 90-95 days. The variety highly resistant to downy mildew disease.
3.	PHBF-1	2009	260	P.A.U. Ludhiana	Suitable for Punjab & Haryana State.	It is a multicut hybrid for green fodder. Plant height 198 cm. It has

						succulent stem, better tillering and long broad leaves. The fodder quality of this variety is superior.
7. Crop : Hybrid Napier– Sowing Time – February- March (Irrigated area) July – August (Rainy season) Seed Rate 5-6 Quintal Root slip or 4-5 thousand stem cutting per acre.						
1	N.B-21	1987	800	ICAR-IARI, New Delhi	Entire Country	It is a fast growing variety with high tillering capacity. Stem are thin and non hairy with long, Smooth and narrow leaves it has low oxalate content.
2	PBN-223	2000	1100	P.A.U. Ludhiana	Suitable for north west zone	It is a non hairy with smooth long and broad leaves it maintain its active vegetative growth for longer duration. Its sprouts earlier in springs session and remains in vegetative growth upto onset of winter. Its winter dormancy period is less.

3	PBN-342	2019	880	P.A.U. Ludhiana	Suitable for north west zone	It is a leafy hybrid with long smooth, non hairy and broad leaves. Its sprouts earlier in springs session and remains in vegetative growth upto onset of winter.
8. Crop : Cowpea– Sowing Time – March- April and June- July Seed Rate 16-20 Kg per acre						
1	HFC.42-1 (Hara Lobia)	1976	140-150	C.C.S.H.A.U. Hisar	Suitable for cultivation and Haryana and Punjab State	This is an erect type variety with dark green foliage and suitable for mixed cropping.
2	IFC-8503 (Bundel Lobia)	1993	160	ICAR-IGFRI, Jhansi	Suitable for north west plane zone	Plants height is 140-150 cm with 4-5 branches. The growth habit is erect to semi erect with tendrils. The leaves are medium to broad and light green colour. The variety is suitable to drier area of country.

3	C.S-88 (Haryana Lobia)	1996	140-150	C.C.S.H.A.U. Hisar	Suitable for Haryana State	This is suitable for Cultivation in summer and rainy season. Plants growth is erect nature, having long and broad leaves. It is suitable for mixed cropping.
4	C.L367	2005	110	P.A.U. Ludhiana	Suitable for Haryana and Punjab State	This is an early short duration verity. It is dual purpose for fodder as well as pulse purpose. Its plants are erect with dark green leaves. It is resistant to yellow mosaic virus and anthracnose disease. Its fodder quality is superior. It bears large number of Pods. The variety is suitable for human consumption because it has very good cooking quality.
5	U.P.C 625	2009	160	G.B.P.U.A & T,	Suitable for Entire Country	It is a white seeded variety and used for dual purpose. It leaves stay green

				Pant Nagar		at pod maturity. It has higher leaf stem ratio. Suitable for mixed intercropping with sorghum, maize & Bajra.
9. Crop: Guar (Cluster bean) Sowing time: 1st week of April – Mid July. Seed Rate 18-20 Kg per acre						
1.	Guara-80	1990	125	P.A.U. Ludhiana	Recommended for cultivation in north west zone of country	It is tall, quick growing, hairy and profusely branches type. It is resistant to guara leaf blight disease. It is a late maturity variety.
2	Bundel Guar -3 (IGFRI-1019-1)	1999	160	ICAR-IGFRI, Jhansi	Recommended for entire guar growing area.	It is a dual purpose variety suitable for fodder as well as grain type. The maturity of this variety is 50-55 days. It is moderately resistant to bacterial leaf blight and powdery mildew disease. Highly tolerant to shattering and reasonably resistant to drought

						situation.
3	HFG-156	1987	145	C.C.S.H.A.U. Hisar	Recommended for cultivation in Haryana.	It is a tall branched and tolerant to disease. It is suitable for cultivation in Haryana.
4	Guar Kranti (RGC-1031)	2005	140	Agriculture research station Durgapura	Recommended for cultivation in Rajasthan State	This Variety is medium maturity and suitable for rainfed well drained and sandy loam soil. The plants height 108 cm. And highly branched broad leave. This variety is tolerant to drought condition. Moderately resistant to bacterial blight, Alternaria blight, Root Rot and wilt disease.

Major Reproductive Problems of Dairy Cattle and Good Practices for Improving Reproductive Efficiency

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Major reproductive disorders in Dairy Cattle:

- Anoestrus
- Repeat Breeding
- Uterine
- Puerperal Metritis
- Clinical Endometritis
- Pyometra
- Infections Dystocia
- Abortion & Premature Birth

Anoestrous: Anestrous is considered a problem when cows are not seen in heat. Failure to observe heat and heat detection must always be ruled out as the primary problem. Pregnancy can be psychological cause of anestrous and must always be confirmed before anything tried to such cattle. True anestrous can be confirmed by palpating the ovaries by experts. The overall percent incidence range from 11 to 33% in Indian field conditions.

Repeat Breeding: Repeat breeding cattle that are cycling normally, with no clinical abnormalities, which have failed to conceive after at least three successive inseminations. In practice, some will have been inseminated at the wrong time, others may have pathological changes in the bursa or oviduct that are difficult to palpate or undiagnosed uterine infections. Overall incidence of repeat breeding ranged from 5 to 9% in different breeds of cows and buffaloes, however incidences are higher in crossword animals.

Puerperal metritis is defined as an animal with an abnormally enlarged uterus and a fetid watery red-brown uterine discharge, associated with signs of systemic illness (decreased milk yield, dullness or other signs of toxaemia) and fever > 39.5 within 21 days after parturition. Animals that are not systemically ill, but have an abnormally enlarge uterus and a purulent uterine discharge detectable in the vagina, within 21 days after calving, maybe classified as having clinical metritis.

Clinical endometritis is characterized by the presence of purulent (> 50% pus) uterine discharge detectable in the vagina 21 days or more after parturition, or mucopurulent (approximately 50% pus, 50% mucus) discharge detectable in the vagina after 26 days. In the absence of clinical endometritis, a cow with subclinical endometritis is defined by > 18% neutrophils in uterine cytology samples collected 21-33 days after calving, or > 10% neutrophils at 34-47 days.

Pyometra is defined as the accumulation of purulent material within the uterine lumen in the presence of a persistent corpus luteum and a closed servix. Retention of placenta (ROP)/ retention of foetal membrane (RFM). RFM occurs when the calf's side of the placenta fails to separate from the mother's side. However, separation of the membrane normally occurs after the calf is born (early separation is one cause of stillbirth), so defining the time at which the membranes became retained is not simple. The most commonly used definition is 24 hours after birth. The overall incidence range has been 4 to 18%.

Dystocia: Dystocia is defined as a difficult or delayed birth at any stage of labor. It is important to know the normal aspects of calving in order to determine if the cow/ heifer is experiencing dystocia. The causes of dystocia may be due to many management decision i.e. genetics and nutrition to management of the cow or heifer during delivery. The overall range was 0.5-6%.

Abortion and Premature birth: Abortion in the cow is defined as foetal death and expulsion approximately between day 45 and day 265 of pregnancy. Range of percent incidence was 3-6% for abortion, 1.5-3% for stillbirth and 1% premature birth.

Prophylactic interventions for improving postpartum reproductive performance: Prophylactic interventions through supplementation of Vitamin E and Selenium, assisting cow through hormonal and non-hormonal agents are necessary while postpartum cow is in most stressful period so that cow can reach the productive and reproductive targets fixed in each Dairy heard. It has been found that the higher the number of cycles before 60 days postpartum, higher is the conception rate. Hence, there is a need to maintain the reproductive tract in estrogen dominance until 45 days Postpartum and afterwards in

progesterone dominance before normal breeding through to achieve higher postpartum reproductive performance. Supplementary feeding during pre and early postpartum is more helpful in assisting the high producing cow in its most stressful period. Supplementation of Vitamin E and Selenium results in improving immunity there by significantly reducing the incidence of metritis, retained placenta uterine infections like endometritis matritis etc. Around the time of carving the fat soluble vitamins like retinol, carotene, tocopherol are significantly reduced to 50% which necessitates the Vitamin E and Selenium supplementation.

Integrated reproductive management

For an efficient monitoring of reproduction management, computing and interpreting reproduction or breeding efficiency indexes become very important. The breeding records necessary for calculations of the indexes are: Date of the most recent calving, Date of previous calving for second and later lactation cows, Reproductive status (pregnant/ open and bred but too early to detect pregnancy), Number of services for all cows and Date of first breeding and most recent breeding, if a cow has been bread more than once.

Marketing Strategies for Milk: Ensuring a Healthy and Profitable Industry

Mr. Ashok Kumar Rao, Dairy Consultant

Abstract: Milk is an essential part of the human diet and a significant commodity in the global market. Its demand and consumption are influenced by various factors, including health awareness, changing consumer preferences, and emerging trends. The discussion encompasses product positioning, branding, packaging, pricing, distribution, and promotion. By understanding these marketing strategies, stakeholders in the milk industry can adapt to the evolving market dynamics and maintain a competitive advantage. Milk is something that is consumed by everyone across all market geographically and demographically.

Over 80 per cent of milk consumption in India is that of liquid milk and over 55 per cent of the revenue of large co-operatives, such as Amul and Nandini, comes from selling liquid milk. There are still limited takers for value-added dairy products such as cheese, yogurts or flavoured milk. The Indian consumer – especially the affluent urban consumer – is consuming more value-added products, which bring in bigger profits for dairy companies than raw milk. The phenomenon of working couples, single men and women with high disposable income also provided the impetus to look at the category with fresh eyes. The fact that the Indian cooperatives had largely stuck to basic milk, butter, processed cheese slices and ice cream for many decades, had left a gap in the market that allowed some of the new players to come in with new product offerings.

India has always been the largest producer (an estimated 400 million litre per day currently) and consumer of milk in the world. But it remained a boring market largely because the per capita consumption was low, and most of the milk was consumed in its basic, liquid form, or at best as ghee and some butter.

Out of the 400 million litres of milk that India produces per day, 160 million litres per day (48 per cent) is retained by the producers for their own consumption. The surplus milk that is available for sale is around 240 million litres per day, and out of that only 70 million litres per day is being used by the organised sector – consisting of co-operatives such as **Amul**, **Mother Dairy** and **Nandini** (a brand owned by the Karnataka Cooperative Milk

Producers Federation (KMF), as well as private sector players such as **Nestle** and **Danone**. Over 170 million litres of the surplus milk continues to be with the unorganised sector, comprising traditional *domestic*. In value terms, the Indian milk economy is worth Rs 5 lakh crore, growing at a CAGR of 15-16 per cent, out of which the organised milk economy, is worth Rs 80,000 crore.

You could have a lot of sellers and buyers. Especially in large metros or other big cities, if you start simply by advertising online about A2 milk, you will attract orders. But the key issues in starting are Farm, Storage, Transportation, Distribution Network and Price. Storage is not challenging but transportation plays a vital role as the time taken from the moment the milk is milked from the cows to delivering to the customers, you need to maintain the time schedules as the product is perishable. You could brainstorm on temperature-maintained environments such as refrigerated storages.

1. **Introduction:** The milk industry plays a crucial role in meeting the nutritional needs of people worldwide. It serves as a primary source of various essential nutrients, such as calcium, protein, and vitamins. The marketing of milk involves a range of strategies to engage and influence consumers. This paper aims to explore and analyze the marketing techniques used by various milk companies to increase sales, establish brand loyalty, and adapt to ever-changing consumer demands.
2. **Product Positioning:** Product positioning is the foundation of any marketing strategy. Milk companies often position their products based on their unique selling propositions (USPs). Health benefits, source of origin, and quality are common attributes emphasized in product positioning. For example, companies may promote the inclusion of essential nutrients, such as DHA (Docosahexaenoic acid) for brain development in children, or low-fat milk for weight-conscious consumers.
3. **Branding and Packaging:** Effective branding is crucial in distinguishing a milk brand from its competitors. Brands aim to create a positive perception in consumers' minds, associating their products with trust, quality, and reliability. Unique logos, slogans, and packaging designs are part of the branding efforts. Packaging plays a significant role, especially in the dairy industry, as it directly affects consumer perception and shelf appeal.

4. **Pricing Strategies:** The pricing of milk products is influenced by several factors, including production costs, competition, and consumer perceptions. Price elasticity is a critical consideration in determining the optimal price point. Additionally, companies may use price promotions, bundling strategies, or volume discounts to attract customers and increase sales.

5. **Distribution Channels:** The distribution of milk products requires an efficient and robust network to ensure availability and freshness. Companies can use various channels, such as supermarkets, convenience stores, online platforms, and direct-to-consumer models, to reach different customer segments effectively. The choice of distribution channel impacts accessibility, product reach, and overall market penetration.

6. **Promotion and Advertising:** Promotional activities are vital to creating brand awareness and persuading consumers to choose a particular milk brand. Companies use advertising campaigns through various media channels, including television, radio, print, social media, and influencer marketing. These campaigns often focus on health benefits, taste, and versatility of milk.

    a) Placing your product in community events, including charity fundraisers, will help your product gain brand recognition and customer loyalty. Look for opportunities to show consumers the value of your product rather than just offer it as a free gift.

    b) Place products in local television programming, including sports events, local news and local programs of interest. Local viewers are as likely to purchase products placed in local programming as those advertised nationally and will be cost effective.

    c) Consider whether your town has a local celebrity with whom you can place your product. This may be a notable athlete or someone from your hometown who has gained recognition throughout your region.

    d) Try gaining exposure for your product through local theatre, including school, community and regional productions. Local businesses from car dealerships to jewellery stores and shoe shops find success placing their products this way.

7. **Targeting Specific Consumer Segments:** The milk industry has diversified its offerings to cater to specific consumer segments. Companies have launched specialized milk products for lactose-intolerant individuals, athletes, and children. By targeting these niche markets, milk companies can capitalize on unmet needs and generate brand loyalty. Identify who your customers are and their demographics, such as age, income, and lifestyle. This information will help you tailor your messaging and communication channels

8. **Social and Environmental Responsibility:** Consumers increasingly value brands that demonstrate social and environmental responsibility. Milk companies may invest in sustainable farming practices, animal welfare initiatives, and environmentally friendly packaging to appeal to ethically conscious consumers.

9. **Innovation and New Product Development:** To remain competitive, milk companies continuously innovate and develop new products. This can involve introducing flavored milk options, plant-based alternatives, or fortified milk with additional nutrients. Innovation helps maintain consumer interest and adapt to changing dietary trends.

10. **Health and Nutrition Communication:** Health and nutrition are paramount concerns for consumers when choosing dairy products. Milk companies invest heavily in health communication to highlight the nutritional benefits of milk consumption. They often collaborate with nutritionists and health experts to create campaigns promoting the role of milk in supporting bone health, muscle growth, and overall well-being. These campaigns also address specific health concerns like calcium deficiency, osteoporosis, and childhood nutrition. Provide value-added content: Share recipes, tips, and educational content that can engage your audience and showcase the versatility of your milk products.

11. **Online Presence and E-commerce:** In recent years, the internet has revolutionized marketing, and the milk industry is no exception. Milk companies have embraced the digital age, establishing a strong online presence through websites and social media platforms. They engage with consumers through interactive content, recipes, and health tips. E-commerce platforms have become crucial for direct-to-consumer sales, subscription services, and personalized offers. The massive rise in internet penetration and

the recent COVID-19 pandemic has presented huge growth opportunities for digital sales of dairy and milk-based products. Fulfilment options such as click and collect and on-demand delivery has grown exponentially, as every consumer is now ordering fresh perishables online daily. All this is leading to a self-sufficient and viable dairy ecosystem, which is a win-win proposition for all. Hopefully in the next two decades, as the market becomes more defragmented, supply chains strengthen and innovations rise, India would transform into a global dairy superpower with dairy production at its peak. Tech-backed milk and milk-product delivery platforms are likely to grow even further over the next few years.

12. **Partnerships and Collaborations:** Collaborations with other brands and organizations offer milk companies unique marketing opportunities. Partnerships can involve co-branding initiatives, where two brands join forces to create limited edition or special product offerings. For example, a milk brand may collaborate with a cereal brand to promote milk consumption with breakfast cereals.
13. **Consumer Engagement and Loyalty Programs:** Creating a loyal customer base is essential for long-term success in the milk industry. Companies utilize customer engagement strategies, such as loyalty programs, contests, and rewards, to encourage repeat purchases and foster brand loyalty. These programs often offer discounts, exclusive content, and personalized offers to incentivize consumers to choose their brand consistently.
14. **Market Research and Consumer Insights**: Successful marketing strategies are based on a deep understanding of consumer preferences and trends. Milk companies invest in market research to gather insights about changing consumer behaviors, demands, and attitudes toward dairy products. This data-driven approach helps companies make informed decisions about product development, packaging, and promotional activities.
15. **Participate in industry events:** Attend industry events and conferences to network, learn about new trends, and showcase your milk products to potential customers.

16. **Leverage customer reviews:** Encourage your customers to leave reviews and testimonials about your milk products, which can help build trust and credibility.
17. **Public Relations and Crisis Management:** The milk industry occasionally faces challenges related to safety concerns, animal welfare, or environmental issues. Effective public relations and crisis management are crucial to addressing these challenges and maintaining brand reputation. Timely and transparent communication is essential in reassuring consumers and rebuilding trust during difficult times.
18. **International Market Expansion:** The global milk market offers significant growth opportunities for milk companies. Expanding into international markets requires a tailored marketing approach that considers cultural nuances, local preferences, and regulatory requirements. Companies may adapt product formulations, branding, and packaging to resonate with diverse consumer bases.
19. **Product Variety and Segmentation:** Milk companies diversify their product portfolios to cater to different consumer segments. They offer various milk options, such as whole milk, skim milk, lactose-free milk, and flavored milk, to accommodate diverse preferences. Moreover, they may create separate product lines for adults, children, and athletes, each highlighting specific benefits relevant to the target audience.
20. **Influencer Marketing:** Influencer marketing has become a powerful tool for reaching target audiences. Milk companies collaborate with influencers, such as fitness enthusiasts, nutritionists, and mommy bloggers, to promote their products and engage with their followers. These influencers provide authentic and relatable content, which can significantly impact consumer perception and purchasing decisions.
21. **Sustainability and Ethical Marketing:** As consumer awareness about environmental issues grows, milk companies are increasingly focusing on sustainability and ethical practices. Brands may highlight their commitment to eco-friendly farming methods, animal welfare, and reduced carbon footprints in their marketing messages. Sustainability initiatives resonate with conscious consumers, creating a positive brand image.

In order for your dairy products to be seen at a grocery outlet, you will need the following:

1. Packaging
2. Advertising
3. Accounting / Financial management
4. Customer Service
5. Consumer marketing
6. Sales management
7. Food Safety
8. Law
9. Human Resource
10. Operations Management
11. Store design (Food centre/ Convenience store)
12. Marketing methods
13. Retails Systems & Operation
14. Labour
15. Marketing Retailing
16. Business
17. Company Analysis

The future of the dairy industry is D2R (Direct to Retailers), for example the largest dairy companies in the world like Dairy Farmers of America, Fonterra, Nestlé, Amul (GCMMF), and Danone all actively adopt these models and D2C (Direct to Consumers), the dairy co-operatives and milk federations of respective states (like Mother Dairy in West Bengal, Aaarey in Maharashtra, Aavin in Tamil Nadu, Nandini in Karnataka, etc.) and private players like Heritage Foods, Creamline Dairy Products, and Schreiber Dynamix Dairy. –This model has gained popularity during the recent COVID-19 pandemic, as consumers have shunned physical stores and favored direct door-delivered purchases. Prominent examples of this model include Kiaro – a Hyderabad-based app-driven organic dairy products brand, Parag Milk Foods' 'Pride of Cows' in Mumbai and Pune and Milk Mantra's Milky Moo in Bhubaneswar and Cuttack.

Conclusion:

The milk industry's marketing strategies play a vital role in fostering consumer engagement and brand loyalty. Successful companies are those that effectively communicate the health benefits, quality, and sustainability of their milk products. By continuously evolving their marketing strategies to align with consumer preferences and trends, milk companies can ensure a healthy and profitable future for the industry

The milk industry's marketing strategies have evolved significantly to meet the demands of health-conscious and environmentally aware consumers. Companies focus on product positioning, branding, pricing, distribution, and promotion to gain a competitive edge in the market. Digital marketing, partnerships, and consumer engagement play crucial roles in building brand loyalty and customer retention. With continuous innovation, adaptability to consumer preferences, and a commitment to health and sustainability, milk companies can ensure a thriving and profitable industry in the years to come.

So, as far as the marketing and advertising is concerned, all the parameters mentioned above play an important role as people are genuinely interested in what conditions and how the product reaches from the farm to their house due to health, sanitation and purity being the utmost points that could make a difference in making people buy the product. You could communicate all your practices by way of digital marketing. Developing an app would further ease the operations as currently the companies are doing.

Remember, marketing is an ongoing process, and you should continuously monitor and adjust your strategies based on customer feedback and market trends.

Basic Animal Nutrition and Importance of Minerals and Vitamins

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Dairy animals Cows and buffaloes are ruminants and have a compound four chambered stomach. They mainly feed on roughages. Rumen is the first and largest compartment of their stomach which harbours microbes. Some of these microbes interact with each other in a synergistic fashion to extract energy from the ingested roughages etc. These microbes produce highly active lignocellulolytic enzymes supporting digestion of the host. This yields volatile fatty acids (VFAs; acetate, butyrate, propionate), formic acid, carbon dioxide, methane etc. The microbes ultimately produce microbial protein mass and volatile fatty acids etc which are ultimately utilized by the animal. These microbes become fully functional when calf attain age of about 3minths, till that we must feed calf milk or milk replacer etc,

Calf feeding:

Colostrums is the first milk produced by the cow after calving and contains special nutrients and antibodies which are essential to protect the calf from disease. The newborn calf can absorb antibodies from the colostrums but begins to lose this ability from about six hours after birth. In addition, the concentration of antibodies in the colostrums diminishes rapidly after the cow has calved and is reduced markedly after two milkings. In indigenous cows and buffaloes, separation of calves from their mothers is not very successful, as the dam may not let down milk without suckling or the presence of the calf, so this should only be practised, if at all, in crossbreds.

Every calf should receive colostrums (about 10% of body weight i.e., about 2 - 3 litters in one day). The first dose should be given as soon as possible after birth, and within the first six hours. If it is suspected that if a calf has not received this colostrum, then a suitable substitute should be given to the calf as soon as possible and certainly within 24 hours of birth. Although antibodies present in the colostrums cannot be absorbed by the calf beyond 36 hours after birth, colostrums, either fresh or stored, should be fed for the first 4-5

days of the calf's life, as it can provide local immunity in the gut and is a highly digestible, high-quality food. Use good hygiene practices when collecting, storing, and feeding colostrums, and check the quality: it should not come from mastitis infected animals.

Where proper feeding management is possible, the young calf may be separated from the mother (i.e., not allowed to suckle) and fed colostrums/milk by bottle. Otherwise, the calf should be allowed to suckle from the dam, ensuring that the calf is getting the required quantity of milk. Offer milk heated up to 35-40°C (not significantly above the calf's normal body temperature of 39°C).

Calf starters:

For the rumen to develop, it is essential that calves consume a highly palatable source of solid feed (calf starter grain). This is essential because rumen fermentation must occur for the rumen to develop. Bacteria which are present from transfer via the dam and from the environment ferment the solid feed and produce volatile fatty acids (VFA). The four carbon VFA, butyrate, is the most important for rumen epithelial (papillae) development. Feeding starter is necessary for this to occur. Because grain ferments at a faster rate than forage, it is not necessary to feed hay at this stage of life. Typically, calf starter contains whole or crimped or steam-flaked grains along with a pellet. Some starters are completely pelleted, and good quality hay must be fed. Calf starts can be introduced around four week of age starting with50-100 grams and gradually increasing to 750 grams at the age of 3-4 months, at this stage milk feeding can be gradually reduced and stopped. There after roughages and concentrate mixture can be fed as per requirements,

Dairy farmers must understand that Dairy animals Feeds are classified into three main types: (1) roughages, (2) concentrates, and (3) mixed feeds (TMR). Roughages include pasture forages, hays, silages, and byproduct feeds that contain a high percentage of fiber. Concentrates are the energy-rich grains and molasses, the protein- and energy-rich supplements and byproduct feeds, vitamin supplements, and mineral supplements.

Mixed feeds commonly called TMR (Total mixed ration) may be either high or low in energy, protein, or fiber; or they may provide "complete" balanced rations. A balanced

ration is the amount of feed that will supply the proper amount and proportions of nutrients needed for an animal to perform a specific purpose such as growth, maintenance, lactation, or gestation. When considering the amount of food and nutrients required by individual animals, various factors need to be taken into account such as the physiological state of the animal, nutritional composition and quality of feed, age, sex, size, body condition, future metabolic needs relative to body condition, state of animal health, growth rate, level of production, previous feeding levels, feeding frequency, genetic effects of breed, level of activity and exercise, maximum periods of food deprivation (e.g. during transportation) and climatic and seasonal factors (e.g. extreme weather).

Many countries have developed standards (NRC 2001, ARC 1980) for livestock feeding through systematic experimentation and careful observations. The Indian Council of Agricultural Research, New Delhi, has published nutrient requirements of cattle and buffalo (ICAR 2013). However, it is not appropriate to specify the complete range of quantities and nutrients required rather than simply following a regime of pre-determined levels of feed, additional information to allow feeding levels to be adjusted according to need can be obtained, by weighing or monitoring body condition score regularly.

Regular body condition scoring is an important management tool, a visual and manual assessment to determine whether animals have been receiving adequate nutrition or more than the nutrients required.

NUTRIENTS OF FEED:

Carbohydrates:

Carbohydrates are nutrients based on carbon, hydrogen, and oxygen. There are more oxygen molecules in carbohydrates than lipids. They are also the largest component in the diet of dairy cattle. Comprising up to 70% of the diet of lactating dairy cattle and more in that of growing heifers and non-lactating cows. Carbohydrates are typically described as sugars and chains of simple sugars. The two most common carbohydrates used in feeding dairy cattle as with other ruminants are cellulose which are β 1,4 linked glucose units, whereas starch is comprised of α 1,4 (amylose), and α 1,4 and α 1,6 (amylopectin) glucose units.

Cellulose is much more resistant to digestion than starches. Therefore, the primary difference is the type of bonds between the glucose units.

Sources of carbohydrates include forages, roughages, grains, and sugars. Forages including hay, hay-crop silage, grain-based silage (corn or small grains) are primarily digested by cellulolytic bacteria which result in the production of acetic and butyric acid. Forages are typically fed with adequate particle size (>3/8 inch) to provide for rumination (the process of regurgitation of cud and the mastication of the forage). This function results in the production of saliva which contains a buffer to help maintain rumen pH (approximately 6.0–6.5). Maintaining H^+ concentration at this amount will help maintain greater numbers of ruminal bacteria and protozoa. An acidic environment (defined as a prolonged time under pH 6) results in lesser numbers of bacteria and poorer feed digestibility. If acidic conditions are prolonged in the rumen, milk fat depression can occur along with laminitis due to histamine from dead ruminal bacteria toxins congesting in the hoof. Therefore, providing adequate forage can optimize rumen health. Roughages can be forages but can also include byproducts such as hulls from soybeans and cottonseeds. Some byproducts can provide ample NDF but are of small particle size and contribute little to saliva production from rumination.

In dairy cattle nutrition, carbohydrates are divided into two fractions: structural carbohydrates and related compounds (cellulose, hemicelluloses, and lignin), and non-structural carbohydrates (starches and sugars). Lignin is not a carbohydrate but is part of NDF. (Neutral detergent fiber). Structural carbohydrates are typically expressed as NDF. Neutral detergent fiber is that material that remains after digesting a dried and ground sample in boiling, neutral detergent solution for 1 h. The material will comprise of cellulose, hemicelluloses, lignin, and any N bound to the fiber. The recommended concentration of NDF to feed is close to 27%–28% of the diet DM (dry matter) for lactating cows. Primary sources of NDF are hays, silage, pasture, and roughages. Acid detergent fiber (ADF) is what remains after NDF is boiled in acidic detergent solution for 1 h. In this process, hemicellulose is lost, and cellulose and lignin remain. Therefore hemicelluloses = % NDF- % ADF.

It is suggested that most cows be fed diets containing greater than 50% of the diet as forages, however, this can vary significantly depending on the inclusion of fibrous byproducts. However, there are instances where more forages can result in adequate production. Heifers and dry cows are fed diets with a much greater proportion of forages than lactating cows due to the lesser nutrient requirements of cattle in these life-phases. Producers need to strive for the highest quality forage as it dictates the purchase of commercial grains and supplements. Higher quality forages (lesser NDF) will result in decreasing the need for purchased feeds and enhance the farm's profits.

Proteins:

Most Proteins are chain of amino acids hooked together. Proteins/amino acids are essential for body tissue growth and milk synthesis (as milk has casein which is a protein). There are essential and non-essential amino acids. Some amino acids and microbial proteins are synthesized in the rumen of the animal. Dietary proteins in ruminants are classified as rumen degradable proteins (RDP) and rumen undegradable protein (RUP). Both types of proteins are required in cows ration for better production. Protein requirement increases with increase in milk production. Proteins are required for body maintenance and milk production etc. NRC and ICAR have mentioned detail of required amount proteins for various categories of animals. Non protein nitrogen (NPN) is nitrogen that commons from sources other than true protein like urea etc. this nitrogen to some extend is utilized by the rumen bacteria for synthesis of microbial protein. Excess of NPN in ration is not desirable. Quality of protein depends on its constituting amino acids quality. Proteins having Basic amino acids and sulphur containing amino acids etc are considered better. Sources of protein are leguminous fodders, oil cakes, pulses (dal chunnis) etc.

Fat:

Fat comprises the most energy dense nutrient with 2.25 times as energy than carbohydrates or protein. Fat is not appreciably fermented in the rumen resulting in little heat of fermentation and can help maintain caloric intake especially when cattle are experiencing heat-stress.

Type of fat:

Fat can be divided into two types, **glycerol, and non-glycerol.** Non-glycerol- type fats have little to no nutritive value and include waxes and sterols; whereas glycerol-type fats include triglycerides, phospholipids and glycolipids and are of nutritive value. These fats contain the glycerol backbone, carbohydrate or phosphate moiety and have long carbon chains. Rumen microbes can incorporate fatty acids into their cell membrane and modify the typical even number of carbon fatty acids into odd C chain fatty acids. Unsaturated fats have double bonds whereas saturated fats are fully hydrogenated. Most plant fats are unsaturated whereas most terrestrial animal fats contain varying amounts of saturated fat.

Rumen inactive fats: High level of Fats that are hydrogenated in the rumen (oils etc) can have deleterious effects on rumen microbes resulting in milk fat depression, decreased dry matter intake and decreased milk yield. These negative effects are a function of how rapidly these fats are available to microbes in the rumen. For instance, cottonseeds, or lightly processed feedstuffs (such as cracked soybeans) will not have a deleterious effect due to their slow release. Further processing (reducing particle size) of higher fat feedstuffs will result in negative effects on rumen fermentation. The oil can coat the fiber and reduce fiber digestibility and result in decreased numbers of microbes.

When rumen microbes are presented with unsaturated fatty acids, they attempt to hydrogenate the double bonds often resulting in isomers that result in milk fat depression. Various dietary factors such as low NDF, small particle size of fiber, high diet ferment ability (high starch), high concentration of unsaturated fat, or more likely, the combination of the factors can result in incomplete bio hydrogenation resulting in increased ruminal production of isomers of C18:2 and C18:1 which can decrease milk fat synthesis in the mammary gland.[31]

Feeding prilled fats (solid at room temperature) will not be hydrogenated in the rumen and will pass to the small intestine for modification and absorption. Fatty acids bound to metal ions (Ca) form soaps and are considered partially protected and will only be moderately broken down in the rumen.

As fats pass through the rumen and reach the small intestine, absorption will occur once fats are emulsified with the help of lysolecithin and absorbed as a micelle. These will be transported to the lymph and then to the heart and partitioned to the necessary organ. In early lactation, fats will be transported to the mammary gland and can be incorporated into milk fat thus saving nutrients for use in other synthetic requirements of the mammary gland (lactose) and often resulting in an increase in milk yield. Post-peak milk production, dietary fat will be stored as adipose for use in the subsequent lactation.

It is imperative to remember that almost all feed items with the exception of water and minerals contain fat. Many lipid-soluble vitamins have isoprene's as their carbon backbones. Carbohydrates typically are associated with about 3% fat with some immature grasses having over 5% fat. Protein meals tend to also have around 3% fat depending on how they are processed while some distillers and brewers grains can contain up to 10% fat. Oilseeds (soybeans, cottonseed, canola, flax) typically have approximately 20% fat while some lesser-used oilseeds (sunflower, pumpkin) can have fat content approaching 45%. Recommendations to feed typically indicate not to feed more than 8% of fat in total dry matter. A typical TMR (total mixed ration) with no supplemental fat will contain about 3%–4% fat. The oilseeds should be cracked for canola, soybean, or flax, but left whole for cottonseed since over processing will result in poor performance by the cows.

As lactation progresses and milk production begins to drop, it is common to remove the inert fat (rumen by pass fat) and as a cow enters late lactation, the oilseeds will typically be removed from the diet. It is recommended that calcium level be increased in the diet when feeding fat to 1% of diet dry matter to reduce any deleterious effects on rumen fermentation.

If fat is fed correctly, early lactation cows should see higher milk yields, sometimes enhanced milk fat content, but almost always a reduced milk protein concentration. However, there may be an increase in milk protein yield (kg) due to the increased milk yield. Cows post-peak should see an increase in body condition. Cows should also experience improved fertility through either greater energy balance or improved hormone concentrations involved in reproduction.

Minerals:

Minerals are essential for optimum health for all living species. Mineral deficiencies can lead to disease and excess can cause toxicity. They are essential for growth, reproduction, production, and maintenance of health as they are involved in many digestive, physiological, and biosynthetic processes in the body. Feeds and fodder are deficient in one or the other minerals. The leguminous forages have been found to be rich in Ca, P, Mg, Fe, Cu and Zn and the non-leguminous forages rich in Mn, but the availability of both macro as well as micro elements reduce with the maturity of the plant. Grains and protein supplements are rich in P but low in Ca.

Minerals are generally classified into two categories.

1. Macro elements (Major elements):

The minerals, which are required in relatively large amount and in most of cases they are used in the synthesis of structural tissues. Their concentration is expressed in term of percentage. The important major elements are calcium, phosphorus, magnesium, sodium, potassium, chlorine, and sulphur. Calcium and Phosphorus: Calcium and phosphorus serve as the major structural elements of skeletal tissue.

Deficiency of calcium may result in an increased incidence of milk fever, decreased feed intake which results in a drop in milk production. About 80% of phosphorus in the body is found in bones and teeth, as calcium phosphate. Phosphorus is present in every cell of the body and almost all energy transactions involve formation or breakdown of ATP. Phosphorus is also intimately involved in acid base buffer system of blood and other body fluids, as component of cell walls and cell contents as phospholipids, phospho-proteins, and nucleic acids. Its deficiency can cause reproductive issues like anestrus.

For efficient utilization of non-protein nitrogen, the dietary nitrogen sulphur ratio should be between 10:1 and 12:1. Deficiency of either N or S hampers ruminal cellulose digestion and reduces animal performance.

Na and K are also important minerals. The Na-K pump is essential for enabling active transport of nutrients (glucose, amino acids and phosphate into cells and hydrogen, calcium, bicarbonate, potassium, and chloride ions out of cells) across the cell membrane.

If the diet is deficient in Mg, it causes hypo-magnesium tetany (also called grass tetany or grass staggers) in young calves or in fresh cows which are shifted to grazing pastures. The symptoms include excessive nervousness, twitching of muscles, laboured breathing, rapid pulse rate, convulsions, and death. Potassium and chloride ions out of cells) across the cell membrane. The deficiency signs include loss of appetite, Intense craving for salt, licking and chewing various objects and general pica.

2. Micro elements (Minor elements or trace elements): These minerals required in trace amounts and usually function as activators or as a component of enzyme system. The concentration of trace elements is expressed in terms of part per million (PPM) since their concentration is very low in the plants and body. The important trace elements include zinc, manganese, iron, copper, iodine, cobalt, fluorine, selenium, molybdenum, chromium, nickel, silicon, tin, and vanadium.

The efficiency of absorption and availability of inorganic elements to the animal depend on the dietary source, interaction with other elements and nutrients, age and physiological status of the animal.

Copper deficiency includes anemia, retarded growth rate and milk yield, diarrhea, de-pigmentation of hair and swelling of the leg bones above the pasterns. Young animals are more likely to be affected by a copper deficiency than mature animals. Copper deficiency suppresses the activity of cellular defense systems, and results in an increased susceptibility to parasitism & disease.

Cobalt: Cobalt is essential for ruminants as it is incorporated into vitamin B12 by rumen microbes and, therefore, affects the formation of blood. The importance of Co and B12 becomes apparent when the observation is made that the main source of energy to ruminants is not glucose as in monogastrics, but from the metabolism of VFAs like, acetic and propionic acids. Vitamin B12 is required for the enzymatic activity.

Zinc plays a major role in disease resistance, immune responsiveness, and certain reproductive hormones. Zinc is known to be essential for sexual maturity, reproductive capacity, and more specifically, onset of estrus. Zn has a critical role in the repair and maintenance of uterine lining following parturition, speeding return to normal reproductive function and estrus. Mild iodine deficiency will produce less milk, have a poor hair coat and have increased incidence of mastitis.

Fluorine, selenium, molybdenum, chromium, nickel, silicon, tin, and vanadium are other essential trace elements essentially required for various body processes and can influence milk production and health.

The poor-quality crop residues have enough Na, K, Fe and Mn but, deficient in Ca, P, Mg and Cu.

Requirement and maximum tolerable limit of minerals for cattle :

Element Requirements and Maximum tolerable limit Major minerals:

Ca, % 0.43-0.77 Max 2.0

P, % 0.28-0.48 Max1.0

Mg, % 0.20-0.25 Max 0.5

K, % 0.90-1.00 Max 3.0

Na, % 0.18

Cl, % 0.25

S, % 0.20-0.25 Max 0.4

Trace elements requirements: Fe, ppm 50 Max; 1000 ; Cu, ppm 10 max100; Zn, ppm 40 max500 ;Mn, ppm 40 max 1000; Se, ppm 0.3 max2 I; Co, ppm 0.1 max10

Mineral supplement should be area specific keeping in mind status of minerals in soil and type of feed/ forages of the region. Never over-feed the minerals especially beyond tolerance levels.

Practically it is very difficult to assess each and all essential minerals in ration of a cow however one has to ensure that in high yielding animals supplementation of commercially available standard mineral mixture should be included in the ration wherever necessary. Mineral mixtures are available with salt and without common salt; Mineral mixtures in combination with vitamins are also available in the market.

Amount of mineral; mixture: 1) Cow, Buffalo: 50-100 g daily, depending upon level of milk production. 2) Adult & non-producing animals: 50 g daily 3) Calves: 25 g daily for better weight gain (or as recommendation of the manufacturer)

Vitamins: vitamins are organic compounds needed in minute amounts that are essential for life. A vitamin must be in the diet or be synthesized by microorganisms in the digestive system and then absorbed by the host animal. Currently there are 14 recognized vitamins of which four are fat-soluble and ten are water-soluble, but not all animals require all 14 vitamins when an animal absorbs an inadequate quantity of a particular vitamin, various responses are observed depending on the vitamin and the degree and duration of deficiency. The most severe situation is a clinical deficiency. Marginal deficiencies of vitamins usually have more subtle and less defined signs but can include reduced growth and milk production, poor reproduction, and increased prevalence of infectious diseases. Research in the past few years has concentrated on water soluble vitamins. However, all cows should be fed supplemental fat-soluble vitamins but not all cows need to be supplemented with water soluble vitamins. Of the 14 known vitamins, only two (vitamins A and E) have absolute dietary requirements for dairy cows. Vitamin A plays a key role in maintaining healthy maintenance of eyes, skin, and the linings of the respiratory, digestive, and reproductive tracts. Vitamin E for proper reproduction etc,

- Supplementing fat- and water-soluble vitamins properly can increase milk production and/or improve animal health resulting in increased profitability but adding excess or unneeded vitamins increases feed costs and can reduce profitability.
- All diets fed to dairy cows (dry and lactating) should be supplemented with vitamins A (approximately 90,000 IU/day), D (15,000 to 25,000 IU/day) and E (500 to 1000 IU/day).

- Supplementing biotin at approximately 20 mg/day can improve hoof health and reduce lameness. Milk production often, but not always, increases.
- Supplementing niacin at approximately 6 g/day is unlikely to affect health or milk production. Some production responses might be observed at 12 g/day.
- Rumen-protected choline fed the first few months of lactation usually increases milk production and is often profitable but profitable responses are less likely later in lactation.

Water Soluble Vitamins

A little is known, whether cows have an absolute dietary requirement for any of the water-soluble vitamins. The liver and kidney of the cow can synthesize vitamin C, and ruminal and intestinal bacteria synthesize most, if not all, of the B-vitamins. The concentrations of many B vitamins are relatively high in many common feeds; therefore, in the vast majority of situations cows do not need to consume any supplemental water-soluble vitamins to prevent clinical deficiency. Based on a survey of the highest producing dairy herds the only water-soluble vitamins fed were niacin and choline and biotin.

The predominant function of the B-vitamins is to act as co-factors for enzymes that are involved in amino acid, energy, fatty acid, and nucleic acid metabolism Many of these enzymes are involved directly in the production of milk and milk components The potential imbalance between supply and need in today's high producing cow increase the likelihood that responses will be observed when B-vitamins are supplemented.

Example of Nutrient Requirement of a High Yielding Cow and Very High Yielding Cow:

Milk production, kg	**25**	**54.4**
DM intake, kg/day	20.3	30.0
Energy, NE_l[b], Mcal/kg	1.37	1.61
Metabolizable protein, g/d	1,862	3,476

RDP[c], %	9.5	9.8
RUP[d], %	4.6	6.9
NDF[e], % min	25–33	25–33
NFC[f], % max	36–44	36–44

[a]DM intake = dry matter intake

[b]NE_l = net energy of lactation

[c]RDP = rumen degradable protein

[d]RUP = rumen undegradable protein

[e]NDF = neutral detergent fiber

[f]NFC = non-fiber carbohydrate

Computer Simulated Modeling in Dairy Farming

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Dairy farming has development an important role in rural development activities of the country, especially in poverty alleviation programs through livestock development, and can boost the rural economy of the country. To understand the technical and economic viability of the project before its execution, one can prepare a simulated computer model, using a computer spread sheet. The preparation of techno economic feasibility model is helpful in making a dairy project report for getting finance from financial institutes and for successful implementation of the project.

Steps for dairy project report preparation using the computer simulated models:

Step 1:

Visit existing dairy farms in the area where proposed activity is to be undertaken and around; collect relevant information.

Step 2: work out relevant technologies for the dairy projects:

Production and management:

- Artificial insemination with superior germ plasma, Embryo transfer technology, synchronization of heat,
- Machine milking system
- Heat stress management systems (shed design, use of cool air, forgers, misters, wallowing tanks)
- Manure Handling System
- Silage based complete mixed ration feeding i.e., TMR (Total mixed ration/Partial mixed ration)
- Precision feeding, least cost feed formulation using computer-based software.

- Feeding management to reduce heat stress (use of yeast, niacin, enzymes, chelated minerals, energy rich ingredients etc)
- Calf feeding management (Use of milk replacers, calf starters etc)

Step 3:

Use computer simulated modeling techniques for projects -economic feasibility analysis.

Make Executable Project plans (including housing and fodder growing arrangements etc.) with the help of competent consultant and experienced project managers.

KEY PRINCIPLES TO KEEP IN MIND FOR DAIRY PROJECT PLANNING

- Work out financial feasibility
- Having a skilled project manager or taking his guidance will reduce stress on the owner.
- Location of sheds and Alignment of building, shading and air flow
- Proper effluent management (Regulations &space)
- Store (size type)
- Comfort of cow and milking staff/staff
- Vehicle access, turning place, parking place.
- Good cow flow/replacement, Efficient breeding system
- Feeding system (Cost, required nutrient supply)

Planning different types of simulated Dairy farming modules, premeditated with different objectives and targets demands sound knowledge of dairy production and other related aspects formulating a project plan requires various steps. A techno-economic feasibility study for the proposed Dairy-farming project considering available resources and markets is an essential and crucial step. The feasibility study under varied conditions, especially under diverse market price structures and other conditions must be undertaken before a project is started. "Computer simulating modeling," using realistic basic technical and cost related

input data, is a very handy and versatile tool to visualize, analyze and compare the different projects, virtually in no time. Not only this, but the modeling can also facilitate managers in planning and directing their future work with respect to livestock farming.

PREPARATION OF VIABLE PROJECT FOR FINANCE:

To obtain financial assistance for dairy projects a techno-economic feasibility report is written and presented to the financial institute. The scheme or project report normally includes all the relevant facts and figures together with economic analysis required to assure the project of its technical feasibility and economic viability before it is financed. Financial institutions study the technical feasibility considering various technical parameters considered for preparing the reports and bank ability considering return on investment, repayment schedule and security aspects.

In India loan from banks with refinance facility from national bank for agricultural and rural development (NABARD) is available. For obtaining loan the farmer/ entrepreneurs should apply to the nearest branch of commercial, co-operative, or regional rural bank in the prescribed application forms, which is available in the above, mentioned banks. Guidance of agriculture field officer/ technical officer or the manager of the bank can also be taken in preparation of the project report. For projects with vary large outlays detail project reports should be prepared as per the requirements of the bank.

Under lending terms, the bank normally defines the rate of interest security, repayment period of loan, maximum possible cost of purchase of animals / equipments and margin money i.e., contribution of entrepreneurs in the total cost of the project. The margin money for small farmers is normally less as compared to medium and larger farmers (normally 5%, 10%, and 15% for small, medium, and large farmers respectively). Bank rates are charged as per the overall guidelines of RBI (normally 11-12% p.a.). Security is as per NABARD /RBI guidelines issued. The repayment period depends upon gross surplus in the financial analysis and preferably within 5-6 years with a grace period of one year. The repayment of the loan is made quarterly/half yearly or annually. The Financial institute as per its landing terms expects insurance of all the Once the bank official ensures the techno-economic viability of the scheme, the bank normally sanctions the loan.

TECHNO-ECONOMIC FEASIBILITY REPORT PREPARATION:

Techno-economic feasibility report of a dairy project should be prepared as per the topics mentioned below.

Sr. N.	Topic
1	Introduction of the project (give current scenario of dairy farming, scope etc. in the proposed area)
2	A) Location and address of the proposed project B) Objective of the project (specify, self employment/ additional income generation etc.
3	Personal details of the entrepreneurs (give following details: A) Status of the entrepreneurs (individual/partnership/co-operative society. B) Category: large/ medium / small/ land less C) Experience of entrepreneurs: agriculture/ dairy farming etc. D) Financial status (give existing loan liabilities and assets etc.) E) Education and technical qualification F) Availability of family labor G) Management capabilities (mentioned self management or hired management)
4.	Investment plan (give item wise and year wise investment plan on housing, equipment, and livestock etc. and giving total outlay)
5	Economic analysis for economic viability (give detail of livestock strength, technical parameters, and rates (purchasing and selling rates) considered for economic analysis, expenditure and income statement, gross profits, cash after disbursing loan installment and loan interest, repayment schedule, return on investment etc. (Detail for this is given on subsequent text under the heading "Computer Simulating Modeling techniques for Techno-Economic Feasibility Analysis"
6	Summary & conclusion (based on economic analysis parameters indicates the techno-economic viability of the project etc.)

The report can be submitted to the financial institution for securing a loan. Even if a loan is not required an entrepreneur must prepare a techno-economic feasibility report. This will help him in studying the feasibility of the project in a specific situation. Further, while executing the project the report will help in it's monitoring by comparing technical and

economical parameters achieved and targeted in the project. He must receive practical training from competent training imparting organization/progressive farmer. Local Krishi Vigyan Kendras / stare agriculture universities ATIC NDRI may also be contacted.

It is highly desirable that before starting a dairy unit an entrepreneur should collect relevant facts and figures about the new enterprise for techno–economic feasibility analysis.

COMPUTER SIMULATING MODELING TECHNIQUES FOR TECHNO-ECONOMIC FEASIBILITY ANALYSIS:

The computer models are indispensable tools for farm managers, in monitoring, future planning and appropriate decision-making for running an enterprise efficiently and economically. The computer models assist a planner or entrepreneur to take up or discard the proposed scheme the modeling tool also help in monitoring and modifying the existing plan with changing environment specially with changing market scenarios.

Realistic basic information on various technical aspects of dairy farming, existing and expected costs and prices of raw and finished products as well as other on other economic parameters are the basis of the simulating modeling technique. The success of the models' results largely depends on the truthfulness of the above-required information. The utmost care should be used while collecting and compiling the information. There is always a need to cross verification of the information collected for the modeling from different sources before incorporating in the structure of the model.

Computer based spreadsheet programs like Microsoft Excel program can be used for structuring the model, through interlinking logistically the various steps required to prepare a techno-economic feasibility plan. Using the available technical information on dairy production, available costs and prices various models using Microsoft Excel programs models for dairy farming has been developed for small-scale to medium-scale farmers. One such model is illustrated below. (The model can be obtained through e-mail, by sending request to the author (psokullu@yahoo.co.in).

Following is a simulated dairy project prepared on excel sheet on computer:

30 COWS DAIRY UNIT MODEL							
TECHNO-ECONOMIC FEASIBILITY REPORT OF PROPOSED DAIRY FARMING UNIT							
RESULTS AT GLANCE:							
		Year-1	***Year-2***	***Year-3***	***Year-4***	***Year-5***	**AV.**
1) CAPITAL REQUIRED (Rs)		4331250					
a) Owners Capital (Rs)		1429313					
b) Loan Amount (Rs)		2901938					
2) RETURN ON CAPITAL INVESTMENT (%)		17.97	18.56	18.90	32.16	35.76	**24.67**
3) BC RATIO		1.21	1.20	1.20	1.33	1.36	**1.26**
4) ANNUAL CASH BALANCE AFTER DEBT SERVICE (Rs)		35276	112116	179732	808538	1020744	**431281**
5) INCOME IF FAMILY LABOUR USED/YEAR (Rs)		384176	380997	416934	429442	442325	**410775**
6) AVERAGE INCOME/MONTH IF HIRED		2940	9343	14978	67378	85062	**35940**

LABOUR (RS)							
7) AVERAGE INCOME/MONTH IF FAMILY LABOUR (RS)		32015	31750	34744	35787	36860	**34231**
8) TOTAL GAINS (paid loan + F. Income + gain in Cow Unit)		1187313	1208885	1269571	1009829	1022712	**1139662**
9) COST OF MILK PRODUCTION (Rs)		34.39	35.64	37.04	37.02	37.03	**36.23**
A) PRODUCTION PARAMETERS CONSIDERED AND LIVESTOCK STRENGTH							
Size of the Dairy Unit (Cows)	**30**	***Year-1***	***Year-2***	***Year-3***	***Year-4***	***Year-5***	**AV.**
Total Estimated animal units (Including calves)		*33*	*36*	*39*	*39*	*39*	37.08
Total lactating cows units		*30*	*30*	*30*	*30*	*30*	30
Average daily milk yield of cow purchased	**15.00**						
Increase in Milk Production Over Previous Year in %			*2*	*2*	*2*	*2*	2.00
Inter-calving period (Months)	**14**						

Culling Rate%	**20**						
B) MILK PRODUCTION PROJECTIONS		***Year-1***	***Year-2***	***Year-3***	***Year-4***	***Year-5***	**AV.**
Total number of expected lactations/year*		25.7	25.7	25.7	25.7	25.7	25.7
Expected Milk yield/Lactation		4500	4590	4682	4775	4871	4684
Total milk production (lit)		115714	118029	120389	122797	125253	120436
Minus milk for feeding calves (lit)(300Lt/calf)		7714	7714	7714	7714	7714	7714
Milk available for sale (lit)		108000	110314	112675	115083	117539	112722
Daily availability of milk for sale		296	302	309	315	322	309
C) TECHNICAL PARAMETERS AND COST OF PURCHASED MATERIAL&SALE PRICES CONSIDERED:							
Market price of cow considered on per liter average daily yield (Rs)				**5500**			
Estimated cost/cow (Rs)				82500			
Estimated Housing +Equipments cost @3/4 of cost /cow unit (Rs)				61875			
Estimated capital Investment /cow unit (Rs)				144375			

Estimated investment on cows				2475000			
Machinery &Equipment (Milking machine, cans, Milko tester etc)				426938			
Estimated total capital (Rs)				4331250			
Rate Of Interest	12						
Margin money (%)	33						
Owners Capital				1429313			
Loan (Rs) =				2901938			
		Year-1	***Year-2***	***Year-3***	***Year-4***	***Year-5***	**AV.**
Annual Increase in Feed Cost, Milk Selling prices & wages %			**3.00**	**3.00**	**3.00**	**3.00**	3.00
Milk Selling Price (Rs)/Lit. :		38.00	39.14	40.31	41.52	42.77	40.35
Purchase price of Green Fodder (Rs)/KG:		1.75	1.80	1.86	1.91	1.97	1.86
Purchase price of Straw (Rs)/KG:		7.00	7.21	7.43	7.65	7.88	7.43
Purchase price of Concentrate (Rs)/KG:		32.00	32.96	33.95	34.97	36.02	33.98
Contractual labor Wages /cow		7000	7210	7426	7649	7879	8115

unit/year							
Number of manager/supervisors hired		**1**	1	1	1	1	1
Supervisors (If required) salary / annum		120000	123600	127308	131127	135061	139113
D) EXECTED SALE PROCEEDS	***Unit Cost (Rs.)***	***Year-1***	***Year-2***	***Year-3***	***Year-4***	***Year-5***	
I) Milk	**38.00**	4104000	4317701	4542397	4778649	5027047	
ii) Misc. Sales							
Animal unit sold (culled) 20% of total animal unit	**41250**	269775	294525	321750	321750	321750	
Value of Surplus Heifers/cows (after3 yr.) sold	**82,500**	0	0	0	424286	424286	
Male calf (disposed of within 2 months)	**50**	643	643	643	643	643	
Female Calf 50%disposed (disposed of within 4-6 months)	**5000**	32143	32143	32143	32143	32143	
Insurance Claim cows (75% cost, of 2%mortality)	**61,875**	37125	37125	37125	37125	37125	

Cow dung/animal unit	**1500**	49050	53550	58500	58500	58500	
iii) Total Sales		4492736	4735687	4992557	5653095	5901493	
E) EXPECTED OPERATIONAL EXPENDITURE							
	Ist year Unit Cost (Rs.)						
		Year-1	***Year-2***	***Year-3***	***Year-4***	***Year-5***	
G. Fodder cost @ 20kg/animal unit	**1.75**	417743	456068	498225	498225	498225	
Straw @ 4Kg/animal unit	**7**	334194	375800	422854	435539	448605	
Concentrate for milk production @ 3Kg/Lit	**32**	1234286	1296741	1362356	1431291	1503714	
Concentrate maintenance @0.5Kg/ani. unit	**32**	190968	214743	241631	248880	256346	
Medicines & AI etc.	**5000**	163500	178500	195000	195000	195000	
Rent/leasing cost for land for Shed etc /A.unit.	**2500**	81750	89250	97500	97500	97500	
Contractual labor Wages /cow unit/year	**7000**	228900	257397	289626	298314	307264	

Salary of supervisor/annum	**120000**	120000	123600	127308	131127	135061	
Insurance premium cows only	**4**	99000	99000	99000	99000	99000	
Electricity charges@ 2500 /animal unit/year	**2500**	81750	89250	97500	97500	97500	
Other misc. charges@2500/animal unit	**2500**	81750	89250	97500	97500	97500	
Replacement cost of animal unit culled	**82500**	495000	495000	495000	495000	495000	
(a) Total operating cost		3528840	3764597	4023498	4124876	4230715	
Operating surplus (Total sale - Operational cost)		963896	971090	969059	1528219	1670778	
(b) Dep. On shed machinery & Equipments	**10**	185625	167063	150356	135321	121789	
Total Exp. (a+b)		3714465	3931660	4173855	4260197	4352504	
F) NET PROFIT		778271	804027	818703	1392898	1548989	
G) RETURN ON CAPITAL INVEST. (%)		17.97	18.56	18.90	32.16	35.76	
H) BC RATIO		1.21	1.20	1.20	1.33	1.36	
I) COST OF MILK PRODUCTION (Rs)		34.39	35.64	37.04	37.02	37.03	

J) LOAN DISBURSEMENT AND PAYMENT SCHEDULE							
YEAR	**Loan**	**Interest**	**Installment**	**Total**			
1	2901938	348233	580388	928620			
2	2321550	278586	580388	858974			
3	1741163	208940	580388	789327			
4	1160775	139293	580388	719681			
5	580388	69647	580388	650034			
6	0	0		0			
K) CASH BALANCE AFTER DEBT SERVICE							
YEAR							
	Open. Surplus	**Payments**	**Cash balance**				
1	963896	928620	35276				
2	971090	858974	112116				
3	969059	789327	179732				

4	1528219	719681	808538				
5	1670778	650034	1020744				
L) CASH BALANCE IF FAMILY LABOUR EMPLOYED (Rs)		***Year-1***	***Year-2***	***Year-3***	***Year-4***	***Year-5***	
		384176	380997	416934	429442	442325	

Innovative Ration and Feed Formulation

Dr P S Oberoi, PhD (LPM), Ex-Principal Scientist
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DAIRY ANIMALS RATION FORMULATION USING AVAILABLE SCIENTIFIC KNOWLEDGE:

Balancing dairy animals' diets is necessary to optimize growth, reproduction, and milk production, thereby exploiting the available genetic potentials of the dairy animals. Other important aspect of the ration balancing is, "economic feeding"; this can be achieved by selecting cost effective ingredients having required nutrients with desired digestibility and flow rate in the digestive track of the dairy animals.

Ration formulation needs information on nutrients requirement (as per ARC or NRC etc.) in terms of Energy, Protein, Vitamins, Minerals etc., for various production functions and their availability from feeding stuffs as well as their efficiency of utilization. In ration formulation meeting correct energy requirement is most important and difficult task in ruminants

Steps for ration formulation:

1. Collect the following information of the group of animals (individual animal for precision feeding): Average body weight, milk production, stage of lactation, milk production level. Size of breed (large or small), daily weight change etc.
2. Collect Nutrient requirements for the above group of animals from reliable standard information sources (NRC 2001; Nutrient requirements of cattle and buffalo ICAR publication).
3. Collect information on the feed ingredients nutrient contents (NRC 2001 publication, Nutrient composition of Indian feed and fodder ICAR New Delhi publication) and their availability or use actual true value preferably through various analysis techniques (detergent method or CNCPS recommended). Generally true values after analysis are not available, use best available tabulated values for the ingredients of the ration.

4. Keep net protein requirement and required amount of RDP and RUP as it is highly important, especially for lactating animals.

5. Ensure the recommended level of Fat % including rumen bypass fat.

6 Among minerals, most important major minerals are calcium and phosphorus one must periodically evaluate their status and ensure the required level in the ration. Since assessing essential trace minerals status in the animal as well feeding stuff is complex, consuming, and expensive and is difficult to analyze on routine basis. Practically one has to ensure that at least 50%-70% of these requirements must be supplemented through trace mineral mix, rest may be expected to come through forages and other concentrates ingredients included in the ration/TMR.

7 The use of various feed supplements like buffers, yeast, toxin binders, chelated minerals, bypass fat and bypass proteins etc. should be included as per specific requirements of the animals and must be cost effective.

   a. **use appropriate excel sheet/ software etc. (FAO link https://www.feedipedia.org/content/fao-ration-formulation-tool-dairy-cows, NRC link https://www.nap.edu/catalog/dairymodel/) and insert the required input for the animal whose ration is being prepared and analytical values of the ingredient used.**

      (One can use various software/excel based sheets for ration formulation programs available like the ***FAO Ration Formulation Tool for dairy cows*** *calculates least-cost rations for dairy cows using locally available resources. It has been specifically designed for technicians looking for a simple and easy to use formulation tool. Considering the requirements and available feeding material and their nutritive value an excel-based computer excel sheet can be developed and utilized for ration formulation. A computer-based software has also been developed by NDDB for advising milk producers in local language to balance the ration of their animals with the locally available feed resources and area specific mineral mixture at their doorstep.)*

8 Output (ration formulation) must have required characteristics.

Characteristics of formulated Ration:

1. It must meet the requirements of DMI, Energy, Protein (both rumen degradable as well undegradable protein), Fiber (NDF, ADF minimum values and NFC max values), Dietary calcium percentage, absorbable phosphorus, Mg %,Cl% ,K%, Na% ,S%, Co mg/kg, Cu mg/kg ,I mg/kg, Fe mg/kg, Mn mg/kg. Se mg/Kg, Zn mg/kg. Vitamin A, D, E, IU/day
2. Ensuring consumption of required DMI by the animal and providing required amount of net energy (NE) for various production function through the DMI.
3. The basis of a cow's ration should be high-quality forage.
4. The Ration must be palatable and DMI of the ration should be as per the expected requirement. While formulating ration focus should be on finding ways (palatable, quality ingredients etc.) to make cows eat more ration. This is a strategy to increase milk flow with a minimum increase in feed costs to increase feed intakes.
5. While ration formulation considers DMI during the first month as 2.2% BW at calving and2.8% BW at 14 days and 3.3% at 30 days.
6. Acid neutral detergent fiber should be at least 18 percent and neutral detergent fiber at least 28 percent of ration dry matter.
7. According to bunk management score DMI can be further adjusted for the ration.
8. Added fat shouldn't go above 7 percent of ration dry matter. Fat at over 5% should be furnished by rumen-inert or by-pass fats. Some minerals are used at higher level indicated when fat content exceeds 4.0%. Inclusion of choline as feed supplement can improve utilization of the added fat.
9. The ration differences between groups should be minimal, otherwise cows will decrease milk yield significantly when they are moved to a different

group. Limit differences in concentrate dry matter proportions to not over 10 to 15% between groups

10. Balance rations to meet the nutrient requirements for each stage of lactation.
11. In heat stress conditions, ingredients used for energy sources fibre levels (CHO fractions in ration) should be considered. Further in such ration bypass fat level, Mg level and buffer levels may be readjusted.
12. Cation /anion ratio in transition period and heat stress in TMR may be adjusted.
13. Considering rumination time/frequency, fecal constancy, particles in the feed adjust levels of ingredients especially with high soluble carbohydrates.
14. Feed supplements like live yeast and buffer supplements level may be adjusted as per DMI level, summer stress and fibre contents of the ration.
15. Toxin binder's quality and dose is important and must not bind other essential constituents of ration,
16. In high yielding cow the importance of fiber levels (CHO fractions in ration), should be recognized and appropriately adjusted.
17. Feed additives and supplements of established nutritive value and cost effective should only be included in the ration/TMR. While some feed additives bring a tremendous value and are worth the cost, there are many feed additives not backed by good research
18. If Inclusion of ionophores in ration is necessary as feed additives, use it with caution using proper mixing as higher levels in ration may be highly toxic.

THUMB RULE METHOD FOR RATION FORMULATION

In this method animals tentative body weight, required DMI (dry matter intake) and concentrate roughage ratio of feed for the total dry matter to be fed are used for ration

formulation. For this type of ration formulation necessary change may be done considering body condition of the dairy animals, quality of feed and actual intake of dry matter.

Steps for this type of ration formulation;

I. Calculate the total nutrient requirements (DMI requirement) by adding maintenance requirement as per body weight and lactation requirement as per milk yield.

II. Add 20% of maintenance requirement for 1st lactation and 10% for second lactation.

III. The practical dry matter intake is calculated by adding 2% of body weight and one third of milk yield.

IV. The concentrate and roughage ration is decided based on production level as mentioned below:

Milk Yield (kg)		**Roughage: Concentrate ratio**	
Cattle	**Buffalo**	**Roughage**	**Concentrate**
Up to 6 kg	Up to 5 kg	100	0#
7-14	6-10	70	30
15-20	11-15	60	40
21-30	16-20	50	50*
30 +	20+	40	60*

Such animals should be provided with an appropriate amount of mineral mixture with vitamins. Preferably green roughages.

#Although the low milk production may be supported by supplementing only quality green fodder it is better to provide 1kg concentrate mixture to support animal for higher level of production

* At this level of production appropriate supplements and additives like yeast, buffers, bypass fat etc should be added in ration (in concentrate mixture).

SIMPLE METHOD OF FORMULATING CONCENTRATES:

This simple method is used for formulation of compounded concentrate mixture for cattle and buffaloes having low to medium yields

The following are the proportions of various ingredients for making concentrate, of ingredients.

a. **Cereal Grains: Maize, Bajra, barley any other locally available cereal : 32-40%**

Cereal grains are rich in starch and have moderate amount of proteins. These are considered as energy supplying ingredients in the ration the level should be decided based on the production level and body condition score of animals. Mixture of these grains can be taken, bitter grains can be kept on lower side about 10-15%, maize exclusively can be taken up to 40 %, but buffers must be added in the concentrate ration,

b. **Agriculture byproducts: Wheat bran, Rice bran, Deoiled rice bran, byproducts of pulses processing industry : 28-32 %**

These byproducts generally have more protein than cereal grains but less than protein supplements, rich in phosphorous and fiber and varying amount of fat. Molasses should be5-7%.

Protein supplements (Cottonseed cakes, Mustard oil and deoiled cake, Soyabean meal, Groundnut cake, sunflower meal, guar korma, Guar churl, Maize gluten meal etc.: 30-34% (Mustard cake being bitter should be used about 10-15%) . Protein rich ingredients should be added carefully according to the palatability issues of local area. It is better if we use more than two protein supplements in the ration. Protein is the costliest nutrient and hence ingredients need to be selected carefully. Depending on the availability of roughage and production level of animal these may be reduced or increased.

c. **Mineral mixture: 1.5-2%**
d. **Common salt :1%**

e. **Buffer:0.5%.**

f. **Toxin binder:0.1% (if feed is to be stored for longer time and ingredients are of poor quality this should be added**

g. **Other Feed additives:** for high yielding cows bypass fat 1-2%, yeast 0.1 % may be included

CALF STARTER FORMULATION:

For a calf to grow efficiently, it must have a successful transition from liquid to solid feed. A proper solid feed is required to stimulate rumen development. Solid feeds produce VFA which also stimulate rumen microbes to proliferate. For making calf starter palatable grains like maize and palatable protein supplement like soyabean meal, ground nut cake and byproduct like wheat bran are preferred.

Adequate amount of vitamins, major and trace minerals along with use of probiotics and prebiotics supplements is suggested.

Specifications of calf starter: DCP- 18-20%; CP- 24- 26%; Fat- 5-7%; Crude fibre- <5; TDN- 75-78%.

(Important: For commercial production of concentrate mixtures for different categories of animals, especially for heavy yielding dairy cows/buffaloes, where quantity and quality of concentrate significantly affects milk production and cost of milk production a computer based least cost ration/concentrate formulation techniques should be used with the help of an animal nutritionist.)

Common Diseases of Dairy Animals: Their Symptoms, Control and Preventive Measures

Dr. Satya Pal, Ex CTO, NDRI

Any harmful deviation from the normal structural or functional state of an organism, generally associated with certain signs and symptoms and differing in nature from physical injury. A diseased organism commonly exhibits signs or symptoms indicative of its abnormal state. Thus, the normal condition of an organism must be understood in order to recognize the hallmarks of disease. Nevertheless, a sharp demarcation between disease and health is not always apparent.

The study of disease is called pathology

Haemorrhagic Septicaemia (HS)

This is an acute bacterial disease of cattle and buffaloes which usually occurs during monsoon.

- Mortality rate may be as high as 80 %.
- Germs of this disease survive longer in humid and waterlogged conditions.

SYMPTOMS

- High temperature, sudden decrease in milk yield.
- Salivation and serous nasal discharge.
- Severe oedema of the throat region.
- Difficulty in breathing, animal produces a grunting sound.
- Animal usually dies within 1-2 days of showing symptoms.
- Buffaloes are generally more susceptible than cattle.
- Animals with clinical signs, particularly buffalo, rarely recover.
- In endemic areas, most deaths seen in older calves and young adults.

PREVENTION

- Segregate the sick animal from healthy ones and avoid contamination of feed, fodder and water.
- Avoid crowding especially during wet seasons.
- Vaccinate all animals which are 6 months and above of age annually before the onset of monsoon in endemic areas.

TREATMENT

- Treatment is usually ineffective unless treated very early , that is during the stage when fever sets in.
- Few animals survive once clinical signs develop.
- Case fatality approaches 100% if treatment is not followed at the initial stage of infection.

Get your animals vaccinated anainst H

Black Quarter (BQ) Disease in Cattle

Black Quarter Disease or Black Leg is an acute, infectious disease of cattle and sheep, occasionally recorded in buffaloes, characterised by emphysematous swelling in the skeletal muscles and death due to severe toxaemia and muscle necrosis.

Causal Factors: Usually young muscular and healthy animals are more prone to the infection. The definite causative agent is Clostridium chauvoei, a toxin-producing gram-positive anaerobic bacteria.

Animals affected: Cattle, buffaloes, sheep are generally prone to the disease, very rare in goat and other animals.

Spread of the disease: It is soil borne infection transmitted through wound, injection needle or by ingestion (especially when there are oral abrasions). The organisms are usually deep in soil but outbreaks could occur post-earth moving operations.

Clinical signs: Initially high fever, lameness, with severe depression are classical signs of black quarter disease. Animal stops eating and rumination. Crepitating and gaseous swelling

of the affected muscles of hind quarters and shoulders leading to hot and painful swelling is very characteristic. If not treated immediately, death may occur within 12-36 hours due to severe toxaemia.

Diagnosis of Balck Quarte Disease

- Usually easy to diagnose because of typical symptoms
- Bacteriological examination of exudate smears made from affected portions reveals cigar shaped rods.

Treatment of Balck Quarte Disease

1. Dressing of affected lesions with local injection of penicillin.
2. Inj. Penicillin in large dose and Oxytetracyclin are the antibiotic of choice. Third generation cephalosporin can also be injected.
3. Treatment is usually ineffective in an advanced septicaemic stage.
4. Antibiotic therapy was found to be effective when administered within 12 hours of the appearance of clinical symptoms.

Prevention and control

- In endemic area, vaccinate all the animals above 6 months of age before the onset of monsoon.
- The vaccine should be administered as per the instructions of manufacturers. Burning of the upper layer of soil with straw to eliminate the spores in endemic areas.
- Sprinkle lime or disinfectant over the carcass at the time of the burial.

Brucellosis in Cattle

(Contagious Abortion, Bang's disease)

Infection with *Brucella abortus* can cause abortion, birth of stillborn or weak calves, retained placenta, and reduced milk production. Infected cattle usually abort only once but can still shed the organism in amniotic fluid and milk at subsequent calvings. This is important because the organism is highly infectious to humans. No practical treatment is available;

therefore, efforts are directed at detection of infected herds and preventing infection from infiltrating uninfected herds. Young cattle within a herd often abort within a relatively short timeframe, referred to as an "abortion storm."

Clinical Findings for Brucellosis in Cattle

Abortion is the most obvious sign. Infections may also cause stillborn or weak calves, retained placentas, and decreased milk production. Usually, overall health is not impaired in uncomplicated abortions.

Seminal vesicles, ampullae, testicles, and epididymides may be infected in bulls. Consequently, organisms are present in the semen, and agglutinins may be seen in seminal plasma samples from infected bulls. Testicular abscesses may occur. Chronic infections may result in arthritic joints in some cattle.

Prevention

Vaccination of calves with *B abortus* Strain 19 or RB51 increases resistance to infection. Resistance may not be complete, and some vaccinated calves may become infected, depending on severity of exposure. A small percentage of vaccinated calves develop antibodies against Strain 19 that may persist for years and can cause misleading diagnostic test results.

Bovine Mastitis

Bovine Mastitis is a condition charactarised by the persisitant and inflammatory reaction of the udder tissue due to either physical trauma or infection caused by microorganisms. It is a potentially fatyal mammary gland infection, that is most common in dairy animals. It is a disease that is known to cause the greatest loss to the dairy industry.

Causes

There is a large cohort of microorganism species that are known to cause mastitis. These range from virus, mycoplasma, fungus and bacteria.

Bacterial organisms known to cause mastitis are Pasteurella multocida, Staphylococcus aureus; Str. Zooepidemicus; Str. agalactiae; Str. pyogenes; Str. faecalis; Mycobacterium

bovis; Klebsiella spp; Brucella abortus; Pseudomonas pyocyaneus; E.coli; Leptospira Pomona, etc.

Fungal entities responsible for mastitis are Aspergillus fumigatus; A.midulus; Candida spp; Trichosporon spp, etc.

Physical injury to the mammary region, poor hygiene and/or trauma, also cause this condition.

Symptoms

The clear sign of mastitis is inflammation of the udder that turns into a red and hard mass. The swollen mammary gland is hot and the mere touching causes pain and discomfort to the animal. Animals do not allow touching of the udder even kicking to prevent milking. If milked the milk is usually tainted with blood clots, foul smelling brown discharge and milk clots.

The milk yield totally stops or is severely restricted. Body temperature of the animal increases. Other symptoms are lack of appetite, hindrance in mobility due to swollen udder and pain. The dairy animal develops sunken eyes, suffers from digestive disorders and diarrhoea.

Infected cattle are severely dehydrated and suffer from weight loss. In cases of severe infection there is formation of pus in the infected udder. Mastitis can degenerate to Toxaemia or Bacteraemia and even cause death as a result of acute infection.

Mastitis can be detected at an early stage (sub clinical) before the symptoms appear, through California Mastitis Test (CMT). It is a quick test that can be performed on small milk samples. Early detection helps in preventing the progress of the disease into clinical stages and causing heavy losses to dairy farmers.

Prevention

It is better to prevent mastitis before it becomes a problem. The below measures can go a long way in prevention:

· Provide clean, dry and adequate bedding for cows to lie

- Cows should be clean while entering the milking area
- Use different cloth or paper towel for cleaning the teats on each cow
- Teats should be completely dry and clean before milking
- Use germicidal teat dips after milking
- Feed the cows after milking so that they don't lie down immediately. This prevents the entry of microorganisms into teat canals that are still open from milking.

Treatment

First aid once mastitis has been detected involves applying ice cubes on the udder surface. The infected milk from infested teat should be drained out thrice a day and safely disposed. A composition of 5% phenol can be included to the infected milk to ensure hygienic disposal.

While milking the herd, strict attention must be paid to first milking healthy, non-infected cows and subsequently those infected.

The infected and non-responsive quarter should be dried up, permanently. Calves should be prevented from suckling on the infected teat. A certified veterinary doctor must be consulted, and a course of antibiotic treatment must commence immediately.

Bloat in Ruminants

(Ruminal Tympany)

Bloat is an overdistention of the rumenoreticulum with the gases of fermentation, either in the form of a persistent foam mixed with the ruminal contents, called primary or frothy bloat, or in the form of free gas separated from the ingesta, called secondary or free-gas bloat. It is predominantly a disorder of cattle but may also be seen in sheep. The susceptibility of individual cattle to bloat varies and is genetically determined. Treatment may involve antifoaming agents, emergency rumenotomy, or removal of an esophageal obstruction.

Bloat can be a major cause of sudden death in feedlot cattle. Control measures focused on the administration of antifoaming agents need to be implemented.

Clinical Findings for Bloat in Ruminants

Bloat is a common cause of sudden death in feedlot cattle. Cattle not observed closely, such as pastured and feedlot cattle and dry dairy cattle, usually are found dead. In lactating dairy cattle, which are observed regularly, bloat commonly begins within 1 hour after being turned onto a bloat-producing pasture. Bloat may develop on the first day after being placed on the pasture but more commonly develops on the second or third day.

In primary pasture bloat, the rumen becomes obviously distended suddenly, and the left flank may be so distended that the contour of the paralumbar fossa protrudes above the vertebral column; the entire abdomen is enlarged. As the bloat progresses, the skin over the left flank becomes progressively more taut and, in severe cases, cannot be tented. Dyspnea and grunting are marked and are accompanied by mouth breathing, protrusion of the tongue, extension of the head, and frequent urination. Rumen motility does not decrease until bloat is severe. If the tympany continues to worsen, the animal will collapse and die. Death may occur within 1 hour after grazing began but is more common ~3–4 hours after onset of clinical signs. In a group of affected cattle, there are usually several with clinical bloat and some with mild to moderate abdominal distention.

In secondary bloat, the excess gas is usually free on top of the solid and fluid ruminal contents, although frothy bloat may be seen in vagal indigestion when there is increased ruminal activity. Secondary bloat is seen sporadically. There is tympanic resonance over the dorsal abdomen left of the midline. Free gas produces a higher pitched ping on percussion than frothy bloat. The distention of the rumen can be detected on rectal examination. In free-gas bloat, the passage of a stomach tube or trocarization releases large quantities of gas and alleviates distention.

Treatment of Bloat in Ruminants

- Frothy bloat: antifoaming agents, administered ororuminally
- Free-gas bloat: placement of a rumen fistula or removal of an esophageal obstruction

IA trocar and cannula may be used for emergency relief of free-gas bloat, hour to determine whether the treatment has subspecies paratuberculosis (MAP), primarily affects ruminants

like cattle, sheep, and goats. It is a chronic wasting disease that leads to weight loss, diarrhea, and reduced milk production. The control of Johne's disease involves early detection through testing, culling of infected animals, and improving sanitation and hygiene in calf-rearing practices.

Calf Diarrhea

Calf diarrhea is a common problem in young calves, often caused by bacterial or viral infections, improper feeding practices, or poor hygiene. Adequate colostrum intake, hygienic calf rearing practices, and vaccination against common pathogens can help prevent this disease and improve calf health.

Lameness in Dairy Animals

Lameness in dairy animals is a multifactorial condition caused by various factors such as hoof injuries, laminitis, and infectious agents like digital dermatitis. Regular hoof trimming, improving flooring conditions, and timely treatment of lameness are crucial for preventing and managing this issue.

Conclusion

Dairy animals are vital for the sustenance of the dairy industry, and their health and well-being are paramount for maintaining optimal productivity. By recognizing the common diseases affecting dairy animals and implementing effective preventive measures, farmers and veterinarians can safeguard the health of their herds, ensure sustainable dairy farming practices, and contribute to a safe and healthy supply of dairy products for consumers. Regular veterinary care, hygiene maintenance, and vaccination are key elements in the successful management of common diseases in dairy animals.

Management of Dairy Animals (Birth to Calving)

Dr. Brij Kishore, Ex TO, NDRI

Introduction

Calving is a critical period for both the cow and calf especially the first calves as they are in experienced. Care of the calved animal and new born is essential in order to protect the calf from inclement weather to reduce mortality and to maintain the milk production of the calved animal. The expected date of calving record should be maintained in order to separate the animal 2 weeks before the enert of parturition and kept parturition in calving pens. A separate bedding and comfortable space with feeding and water arrangement is a must. The calved animal is to be washed properly and offered water and udder cleaned for suckling of calf within half an hour after birth. The calf should be taken care by providing colostrum, milk, calf starter, legume fodder etc for good growth.

Care of the Animal Calving

The animal in the advanced stage of pregnancy should be separated from the rest of the animals and placed in the maternity or calving room separately two weeks before the expected date of calving. Check the flooring of the calving pens, which should not be slippery. The floor should be well bedded. Care should be taken to provide water at all times. Two weeks before calving administer calcium intravenously to prevent milk fever in case of high yielder. An attendant should be kept watching the animal. Just before calving, there will be sinking of the croup region. Once the animal starts calving it will show the symptoms like frequent standing and lying down positions. There will be swelling of the udder, vulva region and discharges are noticed. The animal will make peculiar sounds to deliver the calf. Normal birth process takes place around two hours. As a first sign the two front feet of the calf should appear followed by the head of calf. Any abnormal presentation should require assistance by a veterinarian immediately and also in cases which requires more than two hours for calving. Immediately after calving the external genitalia, flank region, tail region should be washed with clean water. The cow should be given adequate amount of water immediately after calving. Once the calf is delivered, the cow will lick its body to make the

body of calf warm. If it does not lick, mucous discharges around nostrils should be removed and the body of calf cleaned with clean cloth or with the paddy straw. Normally the placental membranes will fall off within 2 to 4 hours after birth and disposed of properly. Care should be taken to avoid ingestion of placenta by the cow.

Management of Neonate

Care of calf or Neonate starts when the calf is in the womb of mother. Cows that have been properly fed during the dry period produce up to 25 percent more milk and fat than cows not conditioned. A 0.5 kg gain in body weight per day during the dry period seems to be optimum for satisfactory milk production in ensuring lactation. Immediately after calving the cow licks the body of the calf. If it doesn't happen, remove the mucous discharges from the nostrils. Clean the body of the calf with clean cloth or handful of paddy straw and make the calf dry. If the umbilical cord is not cut, put a ligature 2-3 cm away from body. Cut the navel 1 cm away from ligature with clean scissors. Apply tincture of iodine to the navel cord to prevent infection. Provide clean and warm environment for the calf.

Colostrum should be fed at rate of 8 to 10% of body weight for first 2 to 3 days. Gamma globulins are transferred from mother to calf through colostrums. It works as resistance system for the calf against diseases in the early stages. Colostrums is highly nutritious. It is slightly laxative and prevents constipation. If the calf is weak to drink milk on its own, it is assisted by holding it up to its mother and pour milk into its mouth. The calf is fed with whole milk for a period of 10 to 14 days.

After this, the whole milk may be substituted with skimmed milk, partially in the beginning and completely after two months. The calf should be fed according to its weight, at the rate of 1 kg milk for every 10 to 12 kg body weight per day. Milk replacer is given after 2 weeks of calf age to replace milk. Milk replacer which is, highly digestible should contain minimum of 22% total protein or 20% digestible protein and 10% fat. When calf are raised on limited milk, balanced high energy protein concentrate mixture called as calf starter can be fed from 2nd week onwards till 90 days of age.

A calf starter with 20% protein would be give better growth but it must not contain less than 16% DCP and 70% TDN. A 100 kg Calf starter can be prepared with the following ingredients.

Maize – 50, Ground nut cake – 30, Wheat bran / Rice bran – 8, Fish meal – 10, Mineral Mixture – 2

Besides these, Calves should be fed with good legume grasses or early cut green fodder from second week onwards. This will stimulate rumen development and establishment of rumen microbes. The ideal feeding schedule of calves in general for obtaining optimal growth is as follows.

Colostrum - 3 to 5 days

Whole milk -6th to 40th day

Milk replacer -41st day to 90 days

Calf starter -2nd week to 90 days

Care and Management of Heifers

Well grown and developed heifers are the best foundation stock of a Dairy herd. The female calves after six months of age should be raised separately. Rate of growth is maximum until puberty and then decreases until maturity . Raising of heifers is aimed at

1. Maximum growth and development of heifer
2. Earliest maturity
3. Raising heifer at minimum cost and getting early returns
4. Obtaining good milk yield in first lactation.

Management of heifers can be done in two ways

1. Outdoor system.
2. Indoor system.

Outdoor system: The heifers are raised mainly on grazing conditions rotationally on pasture plots containing legume grass. They are to be shifted from one grazing field to another.

Concentrate feeding can be provided through feed troughs centrally located in the grazing field.

Indoor system: Heifers are kept in the sheds with adequate shade. They should be provide with good quality hays along with the concentrates. The green forages should be fed free of choice and of good quality. Under good conditions of feeding and management a crossbred has to attain minimum of 250 kg to be considered for breeding.

Management of Dry Cows

The pregnant dry cows should be housed in a comfortable paddock and least disturbed. The management of the dry cow is aimed at

1. To give rest to cows udder and recoup its condition lost in previous lactation.

2. Repair and regeneration of secretary cells of udder.

Cows should be properly fed during dry period in order to produce 25 % more milk than which are not conditioned. A 0.5 kg gain in body weight during dry period is optimum for satisfactory milk production in ensuing lactation.

Management of Milch Animals

Management should be aimed such that there is high proportion of milch cows in herd at any given stage. The manage mental practices for higher milk production for longer periods include

1. Feeding balanced ration especially making available good quality green fodders round the year
2. The herd can be divided into high yielders, medium yielders and low yielders and feed them accordingly

3. Providing clean and comfortable houses

4. Prevention of possible management stresses by

A) careful handling and movement of stock,
B) avoiding over stocking,

C) grouping of cows according to age or production,

D) protection of high yielders against thermal stress conditions of summer,

5. Maintenance of high reproduction efficiency in herd.

Applied Aspects of Dairy Animal Physiology and Stress Management

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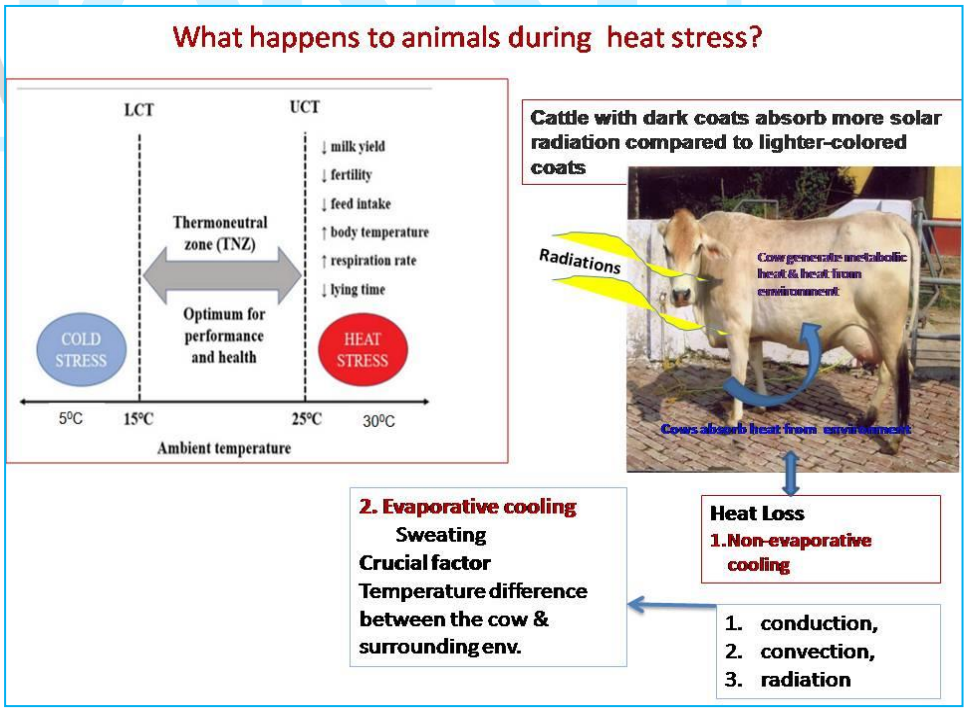
Hot and hot-humid weather conditions cause heat stress in dairy cows resulting in decline in feed intake, milk production and fertility. Animal welfare can be negatively affected when dairy cattle experience extreme weather conditions like heat stress or cold stress. Nowadays managing the heat stress has become more challengeable due to ever-increasing global temperatures and increased number of elite animals having greater metabolic activity. IPPC has predicted rise in environmental temperatures to 1.0°C by 2100 since 1800s. The global temperature is expected to rise further by 1.5°C between 2030 -2052. In hot weather conditions an imbalance between metabolic heat production inside the animal body and its dissipation to surroundings results in development of heat load or heat stress (HS). During thermal stress the foremost reaction in animal responses is to increase respiration rate, rectal temperature, and heart rate or pulse rate, and to decrease the metabolic heat production in body. Stress adversely affects feed intake and thereby reduce growth rate, milk production and reproductive performance. Extreme weather (heat load) can even cause death of animal, if suitable management interventions are not undertaken. Higher ambient temperature also impairs immunity, lowers the quantity and quality of fodder and feeds. However such adverse effects on animals could be reduced to a great extent or eliminated by adopting appropriate stress amelioration practices like availability of good shades, quality feeds and flesh water access, in-house-ventilation, proper hygiene and use of sprinklers or ceiling fan facilities in a dairy farm. High producing animals are typically more sensitive to HS than low producer or meat breeds due to higher metabolic heat production. Hence sustainable dairy farming remains a vast challenge in the changing climatic scenario globally. In this chapter the applied aspects of animal physiology to monitor the heat stress induced changes in milk yield, quality, metabolism and heat stress amelioration measures effects have been discussed.

Thermo-neutral zone

Thermoneutral zone (TNZ) ranges 16-25°C within which an animal maintain normal physiological body temperature (38.4-39.1°C). However ambient temperatures greater than 25°C in a temperate climate and 30-37°C in a tropical climate like India enhance heat gain beyond in comparison to heat lost from body and thus induce HS (heat stress). As a result body temperature, respiration rate (RR), heart rate and rectal temperature (RT) increases beyond physiological limits which in turn affects feed intake, milk production and reproductive efficiency in animals. It has been found that RT of 39°C and RR >60/min indicates that cows are undergoing HS sufficient to affect production traits like milk yield and fertility. However animal being homeotherms can resist heat stress up to some extent depending on species, breed and milk production level. Among dairy animals, goats are the most adapted species to heat stress in terms of milk production, reproduction and disease resistance. Native cattle breed like Sahiwal, Gir, Kankraj and Red Sindhi resist rigor of high temperature, survive and perform better as compared to exotic breeds or crossbred's under tropical environment conditions due to inability of exotic genes to express/adapt under tropical conditions. Night cooling in summer season is must for the animals. When temperature and humidity do not decrease enough at night and their difference is narrow down compared with day temperature, the animals are unable to lose the heat gained during day time, causing these animals to be in a constant state of heat stress.



Effects of HS on Health of Dairy Animals

In tropical and subtropical climate zones, little or no alleviation of heat stress occurs at night due to narrow difference between the high and low temperatures in night also. Cattle with dark coats absorb more solar radiation compared with cows that have lighter-colored coats. Increase in environmental temperature has a direct negative effect on appetite center of hypothalamus to decreases feed intake (DMI). Feed intake begins to decline at air temperatures 25-26°C in lactating cows and the decline is more when temperature rise above 30°C in summer season. At 40°C it may decline by as much as 40% in exotic cows, 22-35% in dairy goats or 8-10% in buffalo heifers. The lower feed intake is a way to decrease heat production in warm environments as heat increment of feeding is an important source of heat production in ruminants. As result, animal experience a stage of negative energy balance (NEB) and consequently body weight and body condition score goes down.

Effect on milk production: Hot and humid season is more deleterious than the hot dry season as humidity increases heat load and significantly decrease milk yield in a cow or buffalo. The milk yield in hot dry season decline by 1-2 kg in cattle and buffalo but it decline more in hot humid season (1.5-3kg/ml) in elite cows. Heat stress during dry period can adversely affect mammary gland development ultimately lead to subsequent milk yield. It has been found that during the hot dry season (temperature, 40-42℃) milk production and DMI is not influenced if water and feeds are provided *ad libitum* in of crossbred cows.

Effect on milk composition: Heat stress reduce milk protein, milk fat, solids-not-fat (SNF) in dairy cow, and the effects are more pronounced in high yielding breeds of cattle and buffaloes. HS reduces fat, protein and short chain fatty acids (SCFAs) and increases long chin fatty acids (LCFAs) in milk. The effects of elevated temperature or heat stress on bulk milk quality in buffalo are less evident than in cattle.

Applied aspects of Animal Physiology

Animal physiology identifies the alteration in the physiological process in organs of animals at various stages of lactation, reproduction and management due to heat stress. A brief highlight of important applied aspects is mentioned below.

1. Temperature humidity index (THI): THI is a scale to measure the stress level in dairy animals. It is also known as discomfort index and is determined by measuring wet bulb and dry bulb temperatures reading on day-to-today basis. When temperature and humidity are high, it causes stress and discomfort to the animals resulting in decline in feed intake and milk yield. High humidity in air impairs the heat-loss from the body surface due to inadequate evaporation which results in accumulation of heat in the body. The ambient temperature can be classified into three categories

1. Heat temperature (>30˚C)
2. Warm temperature (20-29˚C)
3. Cold temperature (> 2˚C)

1. Importance of THI

Johnson and Co-workers in 1963 developed an equation for calculating THI which indicate comfort or discomfort of animals in summer or winter seasons. To calculate THI score, dry bulb and wet bulb temperatures needs to be recorded by thermometers which are easily available in the market. Farmers can hang both the thermometers in animal shed at a height beyond the reach of animals and away from direct solar radiation. The recording of temperature is done at 8am and 3pm daily and THI score is calculated by following formula.

THI = 0.72 (dry bulb temperature, ˚C + wet bulb temperature, ˚C) + 40.6

Example 1	Example 2
Dry bulb temperature = 25˚C	Dry bulb temperature = 40˚C
Wet bulb temperature = 15˚C	Wet bulb temperature = 30˚C
THI_1= 0.72 (25+15) + 40.6 = 69.40	THI_2= 0.72 (40+30) + 40.6 = 91.0

Based on above THI climatic condition '1' is comfortable but condition '2' is highly stressful.

Thom THI: Thom in 1948 used dew point and dry bulb temperature readings for calculating temperature humidly index by following formula.

THI = 0.55 (dry bulb temperature ˚**C**) + 0.2 (dew point) + 17.5

As per Thom THI, if calculated value is< 70 it indicates that 10 % of population is under stress.

However if THI value is >79 or higher, it indicates that all the animals are under stress.

2. Physiological responses. First and foremost important point is to measure the physiological responses to environment like rectal temperature (RT), Pulse rate (PR), Respiration rate (RR) and skin temperature (ST). These parameters are used as heat stress markers under field conditions. Due to proximity to the hypothalamic thermo-sensitive site the tympanic temperature is considered as a reliable method of body temperature. It also has a reduced lag time compared with rectal temperature. An increase in skin temperature and image analysis by UV camera indicates heat stress in cows and buffaloes. Rectal temperature can be recorded by use of clinical thermometer. Heat stress can be determined by following symptoms.

a. Panting

b. Animal Seek shelter/ tree shadow

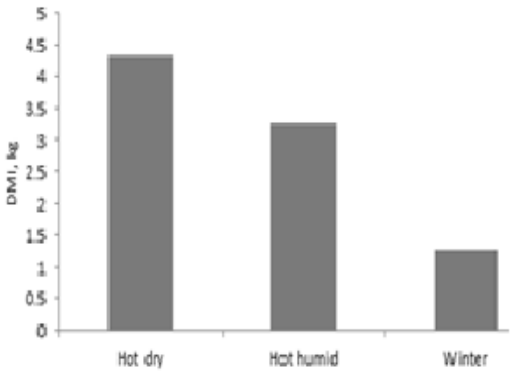
c. Seek watering and stands in isolation

d. Lack of sleep (REM) due to increased time spent on standing alter the endocrine system, increase energy expenditure and weaken the immune system.

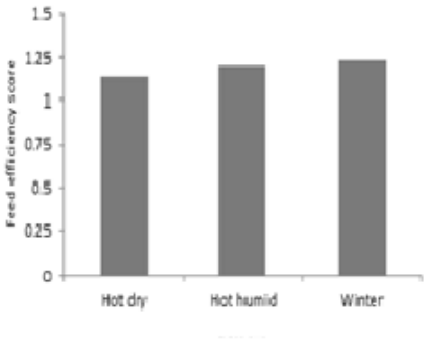
3. Low milk fat syndrome (high propionate than acetate production): During summer season, farmers offer more concentrate mixture due to decrease in DMI and milk yield. As a result more propionate is formed than acetate in the rumen. The propionate is converted to glucose in the liver by gluconeogenesis process and is used for lactose synthesis by the mammary gland resulting to more milk yield. Thus fall in fat percentages in hot or hot-humid season is often observed due to less dietary crude fibre content (CF< 18%) and less acetate production results in low milk fat.

4. Feed and water intakes: Heat stress causes more water intake and decrease in feed intake by stimulating the water and feed intake centers in hypothalamus. High water intake and a

decline in DMI (dry matter intake) by an animal reflect heat stress induced poor feed quality effects on milk yield in summer season.



DMI (kg) for the maintenance in different seasons



Feed efficiency during summer and winter seasons
(3.5%FCM/kg DMI above maintenance requirement)

The feed efficiency of cows is directly influenced by the ambient temperature and significantly affects milk production through reduction in feed intake in tropical climate. The decrease in dry matter intake is more (1-3 kg/d) in hot-humid season (rainy) as compared to hot dry condition. The increase in water intake helps to maintain the homeothermy by effective cooling of body through evaporation.

5. Rumen Microbes: High ambient temperature alters basic physiological mechanisms of rumen microbes due to low fiber intake (DMI), which makes animal more vulnerable to metabolic acidosis and health problems. The ratio of amylolytic: cellulolytic bacteria increase due to high starch diet then the fibrous diet. The dietary change in HS cows reduce acetate production, increase propionate and butyrate production due to altered rumen microbes number and their functioning. Low fibre diet reduce rumen pH (5.80-6.03), decrease reticulo-rumen motility and rumination time. The low fibre intake also results in less chewing, less saliva release and its production. High temperature also decreases metabolic hormone (thyroid hormones) and thereby reduces metabolic heat production (adaptation to high temperature).

6. Detection of mastitis: Detection of mastitis in subclinical stage prevents the losses in milk yield. Subclinical mastitis could be detected by appearance of flakes in milk, watery milk or yellowish milk and low milk yield at the time of milking by visual examination. It can also be measured by performing CMT Calfornia Mastitis Test) by taking 2-4ml foremilk of each

teat in teat-cups before start of milking. Increase in THI can result in an increased risk for mastitis due to high temperatures facilitating the multiplication of pathogens. *Escherichia coli* thrives in temperatures ranging 19.3-44.5°C, and *Klebsiella pneumonia* thrives from 22.7 to 41°C, but these bacteria can't survive at low temperature. The incidence of mastitis in cows increase with increase in THI score (>72) and it initiates decline in milk production in crossbred cows. Dairy herds on pasture had an increased risk of mastitis infections caused by *Streptococcus uberis* environmental organisms which is commonly found in organic matter. Incidence of lamness increases with rise in ambient temperature. The animals spent more time in standing condition in an attempt to increase body surface area for more heat dissipation. Factors like incomplete milking, less frequent milking and mastitis disrupt mammary epithelial cell integrity (junctions) and decrease milk yield. Intact mammary epithelial cell barrier is a prerequisite to maintain maximal milk production. It is an ideal indicator of optimal mammary functions.

Milk composition changes associated with mastitis

	Cow		Buffalo	
Variables	Normal Milk	Mastitic Milk	Normal Milk	Mastitic Milk
Milk Yield (kg)	18.73	0.36	8.06	0.49
Fat %	4.54	2.46	7.26	3.46
Protein %	2.96	3.53	4.89	6.02
Lactose %	4.69	3.62	4.51	3.66
pH	6.47	7.16	6.48	7.16
EC	2.31	3.71	2.56	3.53
NEFA (mM/L)	0.15	0.08	0.16	0.08
Chloride (mg%)	108.25	165.48	92.12	163.97

7. Milk SCC as index of udder health and CMP

Somatic cells are the epithelial cells and immune cells of mammary gland which are sloughed off during the routine milking operations in milk of cows and buffaloes. These cell increases during subclinical and clinical stages of mastitis. Due to this reason milk SCC is used as an index for estimating mammary health and milk quality worldwide. Heat stress

negatively influences the integrity of epithelial tight junctions as stated above. In addition to this heat stress renders mammary gland more prone to mastitis. Cows dried off in summer months are more prone to mastitis than cows died off in cool months.

Mastitis - SCC and Milk loss

SCC cells/ml	Milk loss kg/cow/day
50,000	0.0
100,000	0.7
200,000	1.4
400,000	2.0
800,000	2.7
1,600,000	3.4

(Hoards-Dairyman, 1997)

Stage		Symptoms
1. Chronic		No visible signs (latent infection)
2. Subacute		Slight changes in milk composition, SCC are elevated, bacteria in milk, no systemic signs visible.
3. Acute	*mild*	Appearance of flakes, clots, swelling of udder.
	severe	Fever, loss of appetite, deprenia, weakness, rapid pulse, dehydration, secretion abnormal, hot quarter.
4. Peracute		Severe signs followed by death.

8. Subacute-ruminal acidosis: Cows housed in confinement experience subacute ruminal acidosis in early lactation, and mid-lactation. Heat stress affects feeding behavior of dairy cattle by causing reduced DMI and high intake of high-energy feeds. The minimal intake of forage predispose the cows to ruminal acidosis

9. Behavioral patterns to identify health and welfare: Measures of lying behavior (11 to 14 h/d lying down) in thermo-neutral zone is an important indicator of cow comfort and provide valuable information on how the cows interact with their environment. Increase in temperature reduces lying down time and increase animal standing time to dissipate more heat.

10. Oxidative stress. Oxidative stress leads to increase in reactive oxygen species (ROS) in different cells and tissues of thermal stressed cows and buffaloes. ROS have negative impacts on normal physiology and body metabolism. The oxidative stress in animal's body can be measured in blood samples by analysis of antioxidants enzymes like superoxide dismutase [SOD], glutathione (GSH) peroxidase, catalase and non-enzymatic antioxidants ascorbic acid, GSH, uric acid, α-tocopherol, β-carotene, pyruvate and retinol. Thus blood levels of these antioxidants can be measured to find out immunity status of animals.

11. Metritis (infection of uterus). It is a major cause of economic losses to dairy farmers. The condition is characterized by an abnormal uterine discharge. Incidence of metritis often

increases during heat stress in late gestation cows and buffaloes due to suppressed uterine defense mechanisms. High ambient temperature in conjunction with high humidity increase pathogen load in the environment that may reduce immunity and induce metritis disease. Such animals have reduced fertilization rate, impaired early embryonic development and increased risk of abortions.

12. Hormonal requirement of lactation. Hormone supplementation or depletion studies in different species help to understand role of hormones (GH, prolactin, cortisol, IGF-I, estrogen and progesterone in mammary gland development, lactation and to enhance milk production.

13. Persistency of lactation: Persistency of lactation is defined as rate of decline in milk production after peak lactation. More is the persistency; higher will be the total lactation milk yield in 305days period of a cow. Persistency could be determined by measuring DNA, RNA and proline contents in mammary tissue.

a. RNA- a measure of synthetic activity

b. DNA-a measure of cell number

c. Proline and Hydroxy proline- Adipose tissue (collagen synthesis/associated tissues)

14. Heat Detection symptoms: Onset of heat in dairy animals is exhibited by the symptoms due to physiological alteration in hormones and size of follicles. Common heat symptoms in cattle and buffalo are mounting behavior, mucus discharge from genitalia, restlessness, rise in body temperature, swelling of vulva, loss of appetite, bellowing, frequent urination, aggressive behavior and decline in milk yield. Based on these symptoms any farmer can identify estrus occurrence in animals and insemination could be done post 12hr of onset of heat.

15. Use of antioxidants: Antioxidants like Zn, vitamin E and herbs like Shatavari or Moringa leaf can be used to ameliorate the heat stress in summer season.

16. Milk Biomarkers of Stress: Milk parameters like plasmin and plasminogen level can be estimated in summer season. Heat stresses induces conversion of plasminogen (PG) to

plasmin (PL) and lower their ratio. Therefore, estimation the milk plasminogen-plasmin ratio is used as marker heat stress impaired milk secretion.

Amelioration of heat stress (Cooling methods)

1. **Heat stress** reduces milk yield upto 2-4 kg/d in high yielding dairy cows (15-20kg/d) and buffaloes (10kg/d) during hot and humid season. In medium producers the milk yield declines by 1-2kg/d in rainy season. Since heat stress causes decrease feed intake and milk yield and also influence composition, certain heat stress amelioration measures needs to be undertaken by the farmers to prevent loss in milk. Several tools are available to reduce heat stress effectsin animals which subsequently improve the overall productivity of cattle and buffaloes. However indigenous cows like Sahiwal, Tharparkar, Red Sindhi and Rathi and Hayrana does not need cooling facilities due to adaptation to high temperatures (heat tolerance). Following are the methods that can be used to ameliorate the adverse effects of environmental stress.

2. Use of Sprinklers: Sprinkler and fan cooling appears to be a viable and cost-effective method to stimulate evaporative cooling. Sprinkler and fan cooling system are very effective in improving the cows comfort as measured by rectal temperature and respiration rate as it normalize the physiological values. Due to this reason the milk production of cattle and buffaloes increases (10-15%) concomitant to more feed intake in cooled animals.

3. Water showers/ Mist- fan cooling. Use of mist and fan have been found to be economical as water use and its wastage is less in mister system as compared to water showers in hot dry conditions. It has also been found that farmers can use mist-fan cooling system without any health risks to animals like mastitis incidence. However in exotic breeds, cooling by air conditioning has been used on an experimental basis and was found to be uneconomical.

4. Fan cooling: Ceiling fan can be used in hot and humid (rainy) seasons for effective heat dissipation from the body surface area. For every six animals one ceiling fan is required. The application of fan cooling in summer season sustained milk production in both cows and buffaloes. In India the use of fan has become a common practice in dairy farms while use of

coolers is negligible. Fan cooling thus offers promising mean to reduce heat stress in dairy animals under field condition.

5. Pond Facility for buffalo wallowing: Buffaloes prefer wallowing in pond water which is a very efficient tool to cool the body and disseminate heat. Such buffaloes consume more feed (DMI) and milk production increases by 10-15% by wallowing in ponds. This practice is a traditional one and still used by farmers. Wallowing in ponds thus improve heat symptoms and overall reproductive efficiency, by exhibiting heat regularly and conceive.

6. Availability of Tree shadow as an effective mean of cooling. The tree shadow cooling is a natural way of providing comfort to animals under field conditions and does not involve any extra cost. Evaporation of moisture from the tree leaves reduce temperature by about 4-6^{o}C. Sand bedding or use of mud or katcha floor with fan during hot and humid season provides effective comfort to the animals, increase milk yield, feed intake and lying time.

संकर एवं देसी गायों को खुले एवं एस्बसटोस शैड आवास में रखने से दुग्ध उत्पादन पर प्रभाव

विवरण	दुग्ध उत्पादन (कि.ग्रा.)		
	दुग्ध उत्पादन /दिन	प्रति जानवर 30 दिन में कुल दुग्ध उत्पादन	अध्ययन के दौरान कुल दुग्ध उत्पादन
संकर गाय			
खुला आवास	20.43	1859	11155
एस्बसटोस शैड	21.12	1922	11535
दुग्ध उत्पादन में सुधार	00.69	63	380
देसी गाय			
खुला आवास	10.68	320.25	1281.70
एस्बसटोस शैड	11.72	351.60	1406.40
दुग्ध उत्पादन में सुधार	1.04	31.25	114.70

7. Ventilation: In-house maintained animals should be provided with ceiling or exhaust fans facilities if proper ventilation is not there in a animal house. Studies in an organized dairy farm revealed that it reduce heat stress in animals by removing respiratory gases which increases temperature of in-house environment. However in-house keeping of livestock needs more light and ventilations to maintain hygiene and to minimize the incidence of mastitis.

Conclusion:

Thermal stress has profound effects on the physiology of feed intake and digestion, alters endocrine profile (decrease galactopoietics hormone levels- prolactin, GH, thyroid hormones) and increases stress hormone-cortisol level. At mammary gland level it enhances conversion of plasminogen:plasmin and decrease milk production by down regulation of milk secretion through activation of the endogenous PG-PL system. Cooling facilities like misters/foggers and fan have been proved to be highly effective in heat stress amelioration and to improve feed intake and milk production. Thus cooling strategy during hot and humid period should be used to prevent alterations in physio-biochemical and endocrine responses. However knowledge of animal physiological responses to heat stress during hot months should be regularly monitored and measured along with milk quality and quantity to make dairy farm sustainable and profitable. Farmers should focus on adoption of comprehensive preventive measures to combat heat stress in domestic animals for clean milk production.

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Clean Milk Production: Ensuring Quality & Safety from Farm to Table

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Introduction: Clean milk production is a crucial aspect of the dairy industry that focuses on maintaining the highest standards of hygiene and quality throughout the entire milk production process. The term "clean milk" refers to milk that is free from harmful contaminants, pathogens, and impurities, ensuring its safety for consumption. The Food Safety and Standards Authority of India (FSSAI) defines clean milk as mammary secretion obtained from healthy milch animals, without any extraneous matter, flavor additives, or colostrum. This write-up delves into the importance of clean milk production, its key components, and the measures involved in achieving and maintaining it

Importance of Clean Milk Production: Clean milk production plays a pivotal role in safeguarding public health and promoting consumer confidence in dairy products. Contaminated milk can carry various harmful microorganisms such as bacteria, viruses, and parasites, which can lead to foodborne illnesses. By implementing clean milk production practices, the dairy industry can significantly reduce the risk of disease transmission and enhance the quality of dairy products

Key Components of Clean Milk Production

Hygienic Farm Environment:

Maintaining a clean and sanitized farm environment is essential to prevent the introduction and spread of pathogens. This includes proper waste management, regular cleaning of milking equipment, and providing clean and comfortable housing for dairy animals

1. **Waste Management:** Proper waste management practices ensure that manure and other waste materials do not contaminate the milk production area or water sources. Waste should be regularly collected, properly stored, and, if possible, turned into compost for later use as fertilizer

2. **Milking Parlor Hygiene:** Milking parlors, where cows are milked, should be cleaned and sanitized before each milking session. This prevents the introduction of dirt, bacteria, and pathogens into the milk
3. **Animal Housing:** Providing clean and comfortable housing for dairy animals reduces stress and minimizes the risk of disease transmission. Regular cleaning and disinfection of animal living areas are essential

Animal Health Management

Healthy cows yield high-quality milk. Regular veterinary care, vaccination programs, and proper nutrition are essential to keep dairy animals in optimal health. Diseases such as mastitis and tuberculosis can lead to milk contamination and reduced milk quality Sick animals should be isolated and treated promptly to prevent the contamination of milk

1. **Vaccination:** Vaccination schedules and preventive measures help maintain the overall health of the herd
2. **Nutrition:** A balanced diet tailored to the specific needs of dairy animals ensures good health and high-quality milk production
3. **Disease Control:** Isolation of sick animals prevents the spread of diseases to the rest of the herd. Treating sick animals promptly is vital to avoid milk contamination
4. **Stripping of foremilk:** The initial streams of milk (foremilk) often contain higher levels of microorganisms. Stripping or discarding the first few streams helps minimize the microbial load in the collected milk

Milking Practices:

Proper milking techniques are crucial to prevent the contamination of milk during the collection process. This involves cleaning udders, using sanitized milking equipment, and ensuring the hygiene of milkers themselves

1. **Udder Preparation:** Properly cleaning and sanitizing the udder before milking reduces the likelihood of contaminants entering the milk

2. **Milking Equipment:** Regular cleaning, maintenance, and sanitization of milking equipment such as teat cups, hoses, and milk storage tanks prevent bacterial growth and cross-contamination
3. **Milker Hygiene:** Milkers should practice good personal hygiene, including hand washing and wearing clean clothing, to prevent introducing contaminants during the milking process
4. **Feed and Water:** Providing clean and uncontaminated feed and water to dairy animals ensures their health and the quality of milk produced
5. **Housing Environment:** Clean and well-maintained housing for dairy animals reduces stress, prevents disease transmission, and contributes to clean milk production

Milk Collection and Transportation:

Once milk is collected, it should be immediately chilled to inhibit bacterial growth. Properly designed and maintained transportation containers are necessary to keep the milk at a safe temperature during transit to processing facilities

1. **Chilling:** Cooling milk immediately after collection inhibits bacterial growth. Rapid cooling helps preserve the quality and safety of the milk
2. **Transportation:** Milk transportation containers should be designed to maintain proper temperatures during transit. Regular cleaning and sanitation of these containers are essential to prevent bacterial contamination

Testing and Quality Control:

Regular testing of milk for quality parameters such as fat content, protein content, and microbial load helps identify any deviations from acceptable standards. Milk that does not meet these standards should be appropriately handled or rejected

1. **Microbial Testing:** Regular microbial testing of milk samples identifies the presence of harmful bacteria. If contamination is detected, appropriate measures can be taken to prevent the tainted milk from entering the market

2. **Chemical Testing:** Analyzing milk for chemical parameters like fat content, protein content, and antibiotic residues ensures the milk's quality and adherence to regulatory standards

Measures to achieve Clean Milk Production

1. **Training & Education:** Farmers and workers involved in milk production should receive proper training on hygienic practices, animal health management, and milk handling techniques. Farmers, farm workers, and milkers should receive training on best practices for cleanliness, hygiene, and milk handling. Workshops and training sessions can help disseminate knowledge effectively
2. **Regular Inspections:** Regulatory authorities should conduct routine inspections of dairy farms, processing units, and transportation facilities to ensure compliance with hygiene and quality standards. Regulatory authorities, health agencies, and quality control bodies should conduct regular inspections to verify that farms and processing units adhere to hygiene and safety standards
3. **Farm Management Plans:** Establishing and following comprehensive farm management plans that cover animal health, waste management, milking protocols, and record-keeping can help maintain clean milk production. Farms should create comprehensive management plans that encompass all aspects of milk production, including animal health, waste management, feed practices, and more. These plans act as guidelines to ensure consistent cleanliness and safety
4. **Investment in Infrastructure:** Dairy farms and processing units should invest in modern and efficient equipment to facilitate proper milk collection, storage, and transportation. Modern milking equipment, cooling tanks, and transportation containers equipped with the latest technologies contribute to maintaining milk quality from farm to processing facilities
5. **Traceability Systems:** Implementing traceability systems can help track the journey of milk from the farm to the consumer, making it easier to identify the source of any contamination issues. Implementing advanced traceability systems that utilize technologies like RFID tags or QR codes allows for the tracking of milk batches from

individual cows to final dairy products. This enhances accountability and enables swift action in case of contamination

Benefits of Clean Milk Production:

1. **Safe for consumption:** Clean milk production ensures that milk is free from harmful microorganisms and contaminants, making it safe for human consumption
2. **Enhanced Keeping Quality:** Clean milk has better keeping qualities, minimizing the risk of spoilage and extending its shelf life
3. **Higher Commercial Value:** Clean milk fetches a higher market price due to its quality and safety assurances
4. **Protection against Zoonotic Diseases:** Zoonotic diseases that can be transmitted from animals to humans are minimized through clean milk production
5. **Quality Value Added Products:** High-quality milk serves as the foundation for producing value-added dairy products like cheese, yogurt, and butter
6. **Safe Transportation:** Clean milk is less prone to bacterial growth during transportation, allowing for longer distances to be covered without compromising quality
7. **Financial Gains:** Farmers can earn better returns by selling quality milk, leading to improved livelihoods and sustainable dairy operations

Role of International Competitiveness:

1. The liberalization of the Indian economy has spurred the need for quality milk production to compete with international brands
2. To succeed in global markets, Indian dairy must prioritize clean milk production to ensure high-quality milk products that meet international standards
3. While various government schemes focus on clean milk infrastructure, there's an increasing need to incentivize milk quality through pricing mechanisms

Conclusion: Clean milk production is not just about providing consumers with safe and nutritious dairy products; it's also about upholding public health and maintaining the reputation of the dairy industry. Clean milk production is a multifaceted endeavor that requires a holistic approach, incorporating proper hygiene practices, animal health

management, and stringent quality control measures. By prioritizing cleanliness, investing in infrastructure, and promoting education, the dairy industry can provide consumers with safe, nutritious, and high-quality dairy products while upholding the reputation of the sector by prioritizing hygiene, animal health, and stringent quality control measures, stakeholders in the dairy sector can contribute to a healthier society and a thriving dairy market.

Dairy Farm Management (Shelter, Animal herd Management & Waste Management)

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HOUSING MANAGEMENT OF DAIRY ANIMALS

Living place or house of cattle is simply known as cattle housing. Good housing is required for raising dairy animals. Because suitable housing is needed for keeping the cattle safe from storm, rain, sun, hot temperature, excessive cold climate and other adverse weather conditions. The principal functions of housing for livestock are: a) health sustaining and comfortable environment to the animals; b) desirable working conditions for labour and supervisory staff; c) Integration of housing with feeding, watering, cleaning, handling and restraining including milking and manure removal system.

The housing systems and other farm structures should be designed, constructed, maintained and managed to assist in the achievement of the Five Freedoms of the animals. The Five Freedoms which form a basis for assessing animal welfare (FAWC, 1993; DEFRA, 2003; Webster, 2005) within a husbandry system are: freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury and disease, freedom to express normal

MINIMUM STANDARDS

1. The housing system selected must ensure adequate climatic protection and comfort to the housed animals for promoting optimum production, health and expression of innate behaviour.
2. The floor space, feeding and watering space available for each animal must meet the standing, resting, loafing, and exercise, feeding and watering requirements of the animal.
3. The number of animals in each group of animals in loose house must not be more than the ability of the animal to recognise their hierarchy for ensuring social stability in the group
4. The floors in dairy animal houses must allow for comfortable sitting, standing up, traction and insulation from ground.
5. Heat and cold stress amelioration strategies in animal houses must be in place to ensure protection of animals against these stresses
6. The animal passages, roads, alleys and walkways must allow for easy movement with good traction.

behaviour, and freedom from fear and distress. In order to maximize their performance and to ensure satisfactory standards of welfare, the animal houses must provide the most basic needs. As an absolute minimum, the housing must provide a comfortable, clean, well drained and dry lying area together with shelter for protection from inclement weather conditions. It must allow the animal to move freely around without risk of injury and certain diseases.

SECTION 2

HOUSING SYSTEMS

There are two types of housing systems which are commonly in use for dairy animals. **inim**

Mainly there are two systems of housing for cattle; loose housing system and the conventional closed housing system.

Loose housing

In loose housing, animals are usually kept loose in a open paddock in groups of 40-50 throughout the day and night except during milking and some other specific purposes like treatment, breeding etc., when the animals are required to be tied. This housing system generally provides continuous manger along with covered standing space, open paddock which is enclosed by brick wall or railing and common water trough. Separate housing structures of calf pens, milking byres, calving pens, bull pens etc., are required for this system. This system is ideal for areas of low rainfall such as Punjab, Haryana Rajasthan, Western U.P. and parts of Gujrat, Madhya Pradesh and Maharashtra. Even at other places this system can be used after making small modifications so as to protect animals from excessive rains. Such houses are cheaper to construct, easier to expand at short notice, more congenial to efficient management, less prone to fire hazards to animals and helps cleaner milk production.

Close (tie) housing

In this system the animals are tied at one place throughout and milking and other routine operations connected with dairy animals are carried out at this very place. This conventional closed system provides greater protection during winter season but the construction cost is

high. There are two types of designs in the system viz. tail-to tail and face-to-face. In tail-to-tail system, which is mostly favoured, the animals do not face each other and their feeding managers are different. On the other hand in face-to-face design, the manger is common. In tail-to-tail system, the dairy farmer can feed the animals on individual basis.

The dairy animals accommodation should give them shelter and enough space to move around and interact with each other. The accommodation should provide enough space for a subordinate animal to move away from a dominant one. It is important to provide as comfortable an area as possible, so that the animals can lie down for as long as they want and have enough space to stand up again. The lying area should be big enough to help keep the cows clean and comfortable and to avoid them damaging their joints. The space allowance for cattle and buffaloes housed in groups should be worked out in terms of the whole animal environment keeping in view the age, sex, live weight and behavioural needs of the stock and the size of the group. The minimum floor space allowances for different categories of dairy animals in loose system of housing and for an average farmer in tie stalls (as per BIS recommendations) are presented in table 1 and table 2 respectively.

Table 1Floor space requirements of dairy animals under loose housing system (BIS: 1223 -1987)

Sr. No	Type of animal	Floor space per animal (m^2)	
		Covered area	Open Area
1	Young calves (< 8 weeks)	1.0	2.0
2	Older calves (> 8 wks)	2.0	4.0
3	Heifers	2.0	4.0-5.0
4	Adult cows	3.5	7.0
5	Adult buffaloes	4.0	8.0
6	Down calvers	12.0	20-25
7	Bulls	12.0	120.0
8	Bullocks	3.5	7.0

* *Based on ISI Standards for housing in India.*

Table 2 Floor space norms for cattle shed for average farmers keeping small number of animals in tie stalls (BIS 11786 – 1986)

No. of cattle	Cow shed		Buffalo shed	
	Length (m)	Width (m)	Length (m)	Width (m)
1	2.5	3.0	2.7	3.4
2	4.2	3.0	5.2	3.4
3	5.7	3.0	7.3	3.4
4	5.6	3.0	6.8	3.4
Calves	2.0	1.5	2.4	1.9

In view of the variability of cattle and buffalo size and live weight belonging to different indigenous breeds and different grades of crossbred cattle, it would be more appropriate to allocate floor space to different categories of cattle as per FAO recommendation under loose houses (table 3) and in tie stalls (table 4) which take into account the live body weight of the animal as well as age**.** The minimum floor space requirement based on the Royal Society for the Prevention of Cruelty to Animals (RSPCA) standards are also presented in table 5.

Table 3 Floor space requirements of cattle based body weights as per FAO

Animal category	Age (months)	Weight (kg)	Shaded area per animal (m^2)	
			Fully covered bedded shed	Shed with exercise yard
Young stock	1.5 - 3	70 - 100	1.5	1.4
Young stock	3 - 6	100- 175	2.0	1.8
Young stock	6 - 12	175 - 250	2.5	2.1
Young stock	12 - 18	250 - 350	3.0	2.3

Bred heifers and small milking cows		400 - 500	3.5	2.5
Milking cows		500 - 600	4.0	3.0
Large milking cows		> 600	5.0	3.5

Table 4 Tie-stall system dimensions (metres) as per FAO

Stall Section	Cow live weight		
	450 kg	550 kg	650 kg
Stall width	1.1	1.2	1.3
Stall length	1.6	1.7	1.8
Manger width	0.5	0.6	0.65

Table 5 Minimum floor space requirement based on the Royal Society for the Prevention of Cruelty to Animals (RSPCA) recommendations

Animal weight (kg)	Minimum bedded lying area (m^2)	Minimum non-bedded/loafing area (m^2)	Minimum total area per animal (m^2)
< 100	1.5	1.8	3.3
101 to 199	2.5	2.5	5.0
200 to 299	3.5	2.5	6.0
300 to 399	4.5	2.5	7.0
400 to 499	5.5	2.5	8.0

500 to 599	6.0	2.5	8.5
600 to 699	6.5	2.5	9.0
700 to 799	7.0	3.0	10.0
> 800	8.0	3.0	11.0

* Space allowances for weights in the range of 200 kg to 800 kg comply with British Standard BS 5502:2005

In loose cattle houses the length of feeding space should enable all the animals in the shed to eat at the same time to avoid aggression during feeding. Feed and water troughs should be designed and located where the animals cannot get into them so that the troughs are kept clean. Where feed and water troughs are provided in the loafing area, the access areas should be sufficiently wide to permit free movement of animals and prevent routes becoming wet and slippery. The feeding and watering space requirement as per BIS are given in table 6 and their dimensions are presented in table 7. The minimum linear perimeter of water trough for a given number of animals in the herd as recommended by the Royal Society for the Prevention of Cruelty to Animals (RSPCA), 2011 is given at Table 8.

Table 6 Feeding manger and watering space requirements of dairy animals

Sr. No	Type of animal	Feeding (manger) space per animal (cm)	Water trough space/ animal (cm)
1	Young calves (< 8 weeks)	40- 50	10-15
2	Older calves (> 8 wks)	40-50	10-15
3	Heifers	45-60	30-45
4	Adult cows	60-75	45-60
5	Adult Buffaloes	60-75	60-75
6	Down calvers	60-75	60-75
7	Bulls	60-75	60-75
8	Bullocks	60-75	60-75

** The actual length and width of water through may be decided as per the strength of group*

Table 7 Dimensions of the mangers and water troughs

Type of animal	Dimensions of manger/ water trough (cm)		
	Width	Depth	Height of inner wall
Adult cows and buffaloes	60	40	50
Calves	40	15	20

Table 8 Minimum linear perimeter of water trough (As per RSPCA 2011)

Sr. No	Herd size	Minimum effective drinking perimeter (m)
1	50	2.25
2	100	4.50
3	125	5.65
4	150	6.75
5	200	9.00

With the commercialization of dairy farming and setting up of large dairy farms maintaining high yielding crossbred cows and buffaloes becoming reality is recent years in India, the farmers at these farms have started constructing individual cow cubicles inside the sheds. Where cubicles are desirable to the constructed these shall conform to the minimum floor space for ensuring cow comfort. The dimensions for free stalls (cubicles) as recommended by Farm Welfare Approved standards for dairy cattle and calves (USA) are presented in table 9 for reference.

Table 9 Dimensions for free stalls (cubicles)

Weight of animal (kg)	Cubicle length	Cubicle clear width between partitions
350-500	6.56 ft (2.00 m)	3.61ft (1.1m)
500-600 kg	7.05 ft (2.15m)	3.77 ft (1.15m)
600-700 kg	7.55 ft (2.30 m)	3.94 ft (1.2m)
700-800 kg	8.2 ft (2.5m)	4.27 ft (1.3m)

***** Farm Welfare Approved Standards for Dairy Cattle and Calves, USA)

Table 10 Dimensions of fence-line feed barriers

Sr. No	Age/category of animal	Throat height (in inches)	Height of neck rail (in Inches)
1	6 - 8 months	14	28
2	9 - 12 months	15.5	30
3	13 - 15 months	17	34
4	16 - 24 months	19	42
5	Adult cows	21	48

The cattle houses should get adequate ventilation and should not allow accumulation of excessive carbon dioxide and other gases. The minimum air space required for cattle of different ages as per RSPCA is given in table 11.

Table 11 Minimum air space requirement of dairy cattle (RSPCA, 2011)

Live weight of cattle (kg)	Minimum unit building volume
Up to 60	7 m^3
61 to 100	10 m^3
101 to 200	15 m^3
> 201	20 m^3

Cattle and buffaloes are highly social herd animals and engage in complex interactions to communicate dominance, subordination and peer bonding within the group. These herds have a strict linear hierarchical structure with the most dominant animal at the top and the most subordinate animal at the bottom. Social rank is largely based on by age and body

weight / size. Older animals have more experience and are thus better placed to compete and larger animals are more capable of physically dominating their smaller herd mates.

When different individuals meet for the first time they fight to establish rank. Once hierarchical structure within a group is established, negative interactions become less common except when animals compete for a limited resource e.g. access to feed, preferred lying areas, access to the milking parlour etc. or when closely ranked animals seek to re-establish or alter the dominance order. Near stable social hierarchy gets established in the group when the members of the group are able to recognize each other and remember their rank. An adult cattle and buffalo can effectively recognize 40-50 another cows/buffaloes. Therefore in order to ensure social stability in the group and minimize the level of aggression the group size should be about 50 and should not exceed 60 animals. Mixing of animals and housing animals in very large groups may disrupt the hierarchy and increase aggression. From a health perspective, frequent regrouping of livestock may increase exposure to pathogens and prolong disease outbreaks. Fraser and Broom (1990) suggest that cattle may recognize a maximum of 50-70 other individuals.

When individuals enter or re-enter an established group they must establish their social rank within the herd. This can only be achieved by interacting with all the animals they meet. Hence it often takes a number of days or even weeks for animals to establish themselves following introduction to the herd. Even in herds with a stable hierarchy, social rank remains important when limited resources such as feed or access to feed are considered (e.g. cows of lower social rank were displaced from the feed bunk more often, particularly at high stocking rates (Huzzey et al., 2006) and high ranking cows spend more time at the feeder following the provision of fresh food (Val-Laillet et al, 2008). This is particularly true for low ranking, high yielding animals.

In any situation, animals of higher social rank are better able to cope and perform because they are able to compete better with their more subordinate group mates. Small changes which are of limited consequence to a low yielding animal can be of huge significance to genetically high producing animals. In order to maximize herd performance as a whole, and

not just the performance of higher ranking individuals it is important to manage the herd, the diet and the environment so that lower ranking individuals are able to fulfill their yield potential without compromising their health and welfare. The approximate number of animals to be housed together in a group in loose houses is given in table 10.

Table 10 Number of animals in a group under loose housing of dairy animals

Sr. No	Type of animal	Number of animals
1	Young calves (< 8 weeks)	Individual or in groups of below 5
2	Older calves (> 8 wks)	Groups of below 15
3	Heifers	Groups of below 25
4	Adult cows	Groups of 40-50
5	Adult Buffaloes	Groups of 40-50
6	Down calvers	Individual
7	Bulls	Individual
8	Bullocks	Pairs

The flooring system of dairy cows housing influences the overall environment experienced by the cows. The flooring material used for resting areas is very important for cow comfort. Cows need a soft, dry, comfortable surface to rest on in order to be healthy and productive. Bedding is an important factor influencing cow comfort and lying time, and consequently milk production and dairy farm profitability. Cows housed in loose houses spend 10 to 12 hours per day standing and the rest of 12-14 hours resting. In order to maximize milk production, a cow should spend over 12 hours or more than 50% of her day lying time in a stall or at pasture (Ryan A., 2010). Cows have a strong behavioral need to rest. Jensen et al. (2004) reported that cows have a very strong motivation to rest, and that this motivation to rest increases as the length of rest deprivation becomes greater. The lying behavior has a high priority for cattle after relatively short periods of lying deprivation. Cows have a definite requirement for resting (lying down) that they attempt to achieve, even if it means giving up some feeding time. Studies show that management factors that interfere with resting

inevitably reduce feeding behavior as well. Cows attempt to maintain a rather fixed amount of lying time, and their well-being is impaired when lying time is restricted for several hours (Metz, 1985).

The benefits of resting include: greater milk synthesis due to greater blood flow through the udder, greater blood flow to the gravid uterus during late lactation, increased rumination effectiveness, less stress on the hoof and less lameness, less fatigue stress, and greater feed intake. Grant (2004) proposed that each additional one hour of resting time translates into 2 to 3.5 more pounds of milk per cow daily. The bottom line is that lying has a higher priority than eating and social interactions for both early and late lactation dairy cows, and that cows compensate for reduced access to resting by spending less time eating to free up time for making up lost resting activity (Munksgaard et al., 2005).

A good amount of rest can only be ensured if the floors in animal houses are such that they encourage the cows sit and take rest. House et al. (1994) cited research that stall surfaces had a profound effect on resting times. They found that the resting times on concrete, insulated concrete, rubber mat, straw on concrete (2"), and mattress were 7.2, 8.1, 9.8, 14.1 and 14.4 hours, respectively. Cows will take more rest when microclimate inside the house is comfortable, when comfortable resting place is available, when they are not over crowded, when surface of the floor is conducive for rest: not hot in summers, not cool in winters and not slippery. The options available to ensure this are paddy straw or other locally available dry crop residues, cow mattresses, rubber mats, dried slurry from biogas plant, brick kiln ash or sand. The sand *is* commonly referred to as the *"gold standard"* for bedding dairy cattle. The practice of housing growing crossbred dairy calves on concrete floors with brick kiln ash as bedding was observed to be better in view of better growth and health performance and improved comfort and welfare of calves as compared to housing of calves on concrete floors with paddy straw bedding or on wooden slated floor.

Sand bedding has several advantages. There is increased lying time, less foot stress, lower incidence of lameness, lower clinical mastitis, less lesions and baldness on the hocks. It provides confident footing and good cushion, balanced growth of hoof and balanced wearing,

reducing need for hoof trimming (Frans Vokey, 2003). Dairy farms switching to sand also reported dramatically reduced feet and leg problems, lower SCC, and lower culling rates (Pepin R., 2010). An earth bed also provides some cushion for cows resting and provides good footing. However, it requires a significant amount of bedding to be used over it for cow comfort. This requires a lot of maintenance.

The loose housing system for dairy cattle and buffaloes is quite suitable and economical for tropical climatic conditions as prevailing in India. However some modifications are required for different regions of country as suggest by planning commission. Primary methods for the modification of environment include i) the provision of shade (with feed and drinking water under the shade ii) evaporative cooling with water in the form of fog iii) mist or sprinkling with natural or forced air movement, and possibly iv) cooling (wallowing) ponds. The incorporation of these methods into an integrated environmental management system which protects cows from the primary sources of heat gain from the environment and takes advantage of opportunities to enhance evaporative heat loss have the best potential for successful abatement of heat stress.

Importance of Breeding Bulls and Semen Handling in Organized Dairy Farms: An Overview

Dr. Brij Kishore, Ex TO, NDRI

Much focus is placed on the importance of proper cow nutrition, but too often the nutritional needs of the bull are ignored. The bull stands in the unique position of being responsible for 50 percent of the reproductive success of herd. Thus, the nutrition of this one animal can affect the conception rate of the entire herd. In order for a bull to conceive the most cows possible, he needs to be maintained on a balanced plane of nutrition so that the nutritional requirements in terms of protein, energy, minerals, vitamins etc. are met.

After puberty, bull produces sperm throughout his lifetime in a continuous cycle. This cycle takes roughly 60 days from initial spermatozoa creation from germ cells up to ejaculation of mature sperm in semen. This means that the nutritional status of a bull for the previous 60 days will affect the quality of semen ejaculated today. It also means that fertility in a bull is ever-changing. Just because he was fertile last year doesn't mean that he will be fertile today. Because sperm production is a continuous process, proper nutrition is critical to maintain peak fertility in bulls. The nutritional quality of feeds and forages can have a tremendous influence on the reproductive performance of bull. Although reproductive failure may occur for several reasons, nutritional management is one of the important contributing factors. If nutritional requirement of a bull is not met, reproduction is the first body function that is sacrificed therefore; outmost care should be given while feeding bulls for better reproductive performance.

Effect of various nutrients on reproductive performance of bulls

1) Energy: Energy is probably the most important nutritional consideration in cattle production. Animals require energy to grow and to keep the body functioning. Carbohydrates and fats are the primary source of energy in the diet. Besides being a source of energy, carbohydrates are building blocks for other nutrients. The excess energy in a diet is deposited as fat, which provides insulation and protection to the body. Energy level in ration has its indirect impact on testicular activities. In male calves, it has been reported that additional

dietary energy enhanced onset of puberty primarily via enhanced testicular function, as measured by increased level of serum testosterone, testicular testosterone, Leydig cell size and sperm production (Nolan et al., 1990). Dietary energy up to a level accelerates pre-pubertal development, but beyond a limit there are no positive effects (Pruitt et al.,1986). Excessive dietary energy (Morrow et al., 1981) as well as critically low dietary energy (Meacham et al., 1963) both can adversely affect libido of yearling and mature beef bulls (Wodzicka-Tomaszewska et al., 1981). In Holstein bulls, low energy intake early in life can delay puberty (VanDemark and Mauger, 1964), but if severely low, then it can permanently impair sperm output (VanDemark et al., 1964).

Level of dietary energy had profound impact on reproductive ability of a bull and should neither be too high nor too less. It should be balanced as per the growing stage and body condition of the animal. High energy diet is preferable for growing bulls, but if the growing bull is over conditioned than it need to be cycled down from that high plane of energy, otherwise it will result in more scrotal fat deposition and hamper sperm synthesis. A bull with thin body condition requires to be kept on higher energy level to hasten the body weight gain. For a yearling growing bull, high energy diet is a common practice in commercial farms to achieve the mature body weight as early as possible so that bull may be sold at higher price in short period. But sometimes, high levels of energy have also been shown to impair sperm output and semen quality (Coulter and Kozub, 1984). It may be due to hampered thermoregulation at testicular level creating deteriorating condition for sperm growth.

2) Protein: Protein is the second limiting nutrient in most rations. It is the principal building block of most tissues. The amount of crude protein in an energy-sufficient diet ranges from 8 to 12 per cent. If dietary energy is not adequate to meet demands, it can be supplied by the breakdown of body fat and muscles. However, there is no way for the body to compensate for the prolonged deficiency of dietary protein. Therefore, diets deficient in protein is more critical as it leads to loss of body condition. Inadequate amounts of protein in the diet, further drops off the daily feed consumption, decrease feed passage rates and declines the overall digestive efficiency. Reduced feed intake results in both a protein and energy deficiency.

Protein is the main body building nutrient and its level in diet directly had bearing on animal's growth and reproduction. It has been seen that ration having high protein (14.45% CP) level had resulted in significantly larger scrotal circumference, greater body weight, higher average daily gains, higher body condition score, higher volume of semen, high sperm motility, semen concentration and more total spermatozoa than the rations with low protein (8.51% CP) levels (Rekwot et al., 1987). Reduced CP% in diet resulted in decreased weight of testes, epididymis and seminal glands. It decreased thickness and diameter of seminiferous epithelium and tubules, respectively (Meacham et al., 1964).

3) Minerals: Minerals play various important roles. Along with building block of skeleton tissue, they are cofactor for various enzymatic and biochemical reactions involved in metabolism, reproduction etc. Minerals as per their requirement in the body are divided into macro-minerals and micro- minerals. Macro-minerals include Calcium, Phosphorus, Magnesium, Potassium, Sulfur, Sodium and Chlorine. Micro-minerals include Cobalt, Copper, Iodine, Iron, Manganese, Selenium, Zinc etc. Copper, Selenium, and Zinc have major role on reproduction as they are the trace minerals most commonly to be deficient in the diet. Copper (Cu): Cu is required for connective tissue metabolism, iron metabolism and for various enzyme activities. It also strengthens immunity. Low copper level reduces reproductive efficiency by inhibiting enzyme activities. Cu deficiency can result in reduced libido, infertility and central nervous system abnormalities in offspring. High levels of iron, sulfur or molybdenum in the soil or additional feed supplements can further exaggerate these deficiency symptoms. Newborns are very dependent on copper acquired during the prenatal period since copper levels in milk are poor. Therefore, proper copper nutrition in gestating females is critical to maintain body stores in newborns. Selenium (Se): Most of the Se found in the testes is associated with phospholipid, hydro peroxide glutathione peroxidase, which is an antioxidant that protects the cells from oxidative stress (Boitani and Puglisi, 2008). Se deficiency results in reduced semen viability (Slaweta et al., 1988). Se in association with thyroxin regulates metabolism and reproduction. Se form complexes with heavy metals to render them harmless. Severe Se deficiency result in white muscle disease, leads to stiffness and heart failure. Unfortunately, the amount of Se required is very close to its toxicity level, thus great care must be taken while supplementing

Se. The maximum level of selenium that can be legally fed to cattle is 0.3 PPM in the total ration (dry matter basis). Zinc (Zn): Zn is essential for spermatogenesis (Apagar, 1985). Zn regulates sperm motility as along with ATP, Zn helps in sperm contraction (Hidiroglou and Knipfel, 1984). Zn affects the production and secretion of testosterone, insulin and adrenal corticosteroids. As an integral component of over 300 enzymes, Zn is associated with numerous biological processes (McDowell et al., 1993). Hypo-gonadism is observed in Zn-deprived bull calves (Pitts et al., 1966). Deficiency reduces pituitary gonadotropin output and androgen production in rats (Kellokumpu and Rajaniemi. 1981). Metabolic interactions may occur between Zn and vitamin A metabolism (Smith, 1982.). Zinc deficient rats have reduced vitamin A (Apagar, 1985). Zinc enhances vitamin A uptake in bovine sperm (Swamp and Sekhon, I975).

Calcium (Ca): Help in sperm capacitation which results increased influx of Ca through plasma membrane. This process assists fusion of the plasma membrane and the outer acrosomal membrane and subsequent initiation of the acrosome reaction (Triana et al., 1980). Ca is important for sperm motility. Sperm motility is correlated with cyclic AMP concentration. Calcium, along with magnesium and manganese, is a potent stimulator of adenylate cyclase, an enzyme that converts adenosine triphosphate (ATP) to cAMP (Rojas et al., 1992). The ratio of Ca to phosphorus should be maintained between 1.5:1 and 3:1 to avoid an imbalance.

4) Vitamins

Vitamin-A: The rat has been used extensively in studies of the effects of vitamin A deficiency upon mammalian reproduction. In the male rat, classic symptoms of vitamin A deficiency include inhibition of spermatogenesis, reduction in testicular size, and decline in testicular steroidogenesis (Ganguly et al., 1980). In the male, vitamin A deficiency is associated with degeneration of testicular germinal epithelium, resulting in either reduction or cessation of spermatogenesis, depending upon the severity of the deficiency (Maynard et al., 1979). Bulls fed diets deficient in vitamin A have delayed puberty, reduced libido, and reduced spermatogenesis (Hodgson et al., 1946). Vitamin-E: Vitamin E deficiency has a deleterious effect on germ cell proliferation. Effect of vitamin E occurs directly or

indirectly on the regulation of intra-testicular factors which regulate specific steps of germ cell development (Cooper et al., 1987). In the male rat, vitamin E deficiency causes a degeneration of the germinal epithelium (Scott, 1978), and Se deficiency results in an inhibition of spermatogenesis (Wu et al., 1973.). In the latter case, supplemental vitamin E does not alleviate the Se deficiency symptoms. Vitamin E deficiency in the male rat does not impair LH and testosterone or FSH and inhibin feedback loops, but rather causes testicular degeneration at the intra-testicular level (Cooper et al., 1987). Vitamin E may affect germ cell development through some mechanism other than as a cellular antioxidant.

5) The effect of calfhood nutrition on gonadotropic hormone secretions: Calf destined to become later maturing bulls with smaller testis had lower amount of LH secretion during the period of the early gonadotropin rise (8- 16 wk of age). Furthermore, increasing circulating LH concentrations at this time by treating calves GnRH hastened pubertal development. In addition, FSH treatments in calfhood also increased scrotal circumference and hastened spermatogenesis. In this regard, FSH has been considered a main driver of Sertoli cell proliferation in pre-pubertal animals. Since Sertoli cell multiplication ceases at 20-25 wk of age in bulls, final testis size in bulls is likely determined in calfhood. Experiments conducted to investigate the effect of calfhood nutrition on pubertal development confirms that superior calfhood nutrition augmented gonadotropin secretion (which is probably mediated by metabolic hormones); this resulted in larger testis at 1 year of age and earlier onset of spermatogenesis (Barth et. al., 2008).

6) Effect of feeding Bull supplement developed by the NDDB:

A bull supplement containing chelated minerals, coated vitamins and herbs was developed by the Animal Nutrition group of NDDB after conducting series of feeding trials on breeding bulls of different breeds. Trial results and economic analysis of feeding the bull supplement of some of the trials are given below in brief. Feeding trials on bull supplement were organized for one full year at ABC, Salon and SAG, Bidaj, on 50 breeding bulls at each farm. One feeding trial was also conducted at BAIF's Bull Station in Uruli-Kanchan, Pune for a period of 6 months on 9 breeding bulls, before commercial launching of the supplement. On feeding the supplement, there was average increase in semen doses by about 329 per bull per

month at SAG, Bidaj, 476 at ABC, Salon and 800 at BAIF. In addition, there was also improvement in sperm plasma membrane integrity and per cent intact acrosomes, as recorded by the QC labs of respective semen stations.

The supplement is now commercially produced in 5 mm pellets by Indian Immunological Ltd. Hyderabad at its cattle feed plant, Rajkot, under the brand name "Nandi Bull Supplement" for improving the quality and quantity of semen in breeding bulls. The supplement is available in packets of 250 g, each of the packets required to be fed daily per bull.

7) Anti-nutritional Factors hindering bull fertility:

i) Gossypol: Chinese researches reported gossypol as a potent male contraceptive. Feeding cottonseed products at high levels and/or for long periods of time hindered bull fertility (Chase et al., 1989). In routine use of 3- 5 lbs of cottonseed meal is most unlikely to expose the breeding animals to the levels of gossypol needed to cause reproductive problems (Martin, 1990). Add 4000 IU of vitamin E/head/day to neutralize the effects of gossypol.

ii) Molybdenum toxicity: Displayed complete lack of libido, and histological examination showed seminiferous tubules and testicular interstitial tissue to be in various stages of degeneration and devoid of spermatids. Damage to germinal epithelial tissue was irreversible (Thomas and Moss, 1951)

Conclusion:

A planned and scientific approach in nutritional management can upgrade the reproductive quality of breeding bulls. Bulls fed as per their actual requirement since calfhood achieve the puberty in right time and have large scrotal circumference and higher gonadotropic hormone release, which result in healthy and fertile sperms.

Recommendations and Suggestions

1. Periodically, feed and fodder offered to the bulls should be tested for their chemical composition and mineral contents.

2. As bulls are aggressive and have competitive feeding habits, thus instead of group feeding, individual feeding should be practiced.

3. Periodically animal weight should be recorded to know the actual body condition of the animal.

4. Ration should be formulated based on requirement of individual animal, considering chemical composition and mineral contents of the existing feeds and fodders.

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