

Nutritional Strategies for Meeting Nutrient Requirement of Dairy Animals for the Targeted Milk Production of 300 Million Tons*

S. Anandan, N.K.S. Gowda and K. Giridhar

Introduction

India is the largest milk producer globally and the recent data indicates that the production is around 231 million tons during the year 2022-23. Species wise cows contribute around 52% while buffaloes and goats contribute 45 and 3% respectively. Based on the milch population and the average productivity of different categories over the recent five years, it is estimated that at the current growth rates the targeted milk production of 300 million tons will be achieved by the year 2027-28. The milch population and the average productivity of different categories and their contribution to the total milk population at current level and targeted production of 300 Million metric tons is presented in **Table 1**.

As per the projected figures in the **Table 1**, it is seen that crossbred will continue to increasingly contribute to the milk pool with substantial increase in their population while the share of buffaloes will decrease although the numbers continue to increase. Growing population and urbanization is fuelling the demand for livestock products. Fulfilling the growing demand for feed against the competing demand for food grains and commercial crops from the limited natural resources like land and water is going to be a major challenge. A key constraint to improve livestock productivity is the scarcity of high-

quality feed and fodder resources in India. The primary sources of cattle feed and fodder have traditionally been crop residues and grazing on common lands, resources that are gradually dwindling. Dairy sector in India is very heterogeneous unlike poultry sector, with wide variation in the breeds, body weights, feeding systems and production potential and functionality. Dairy production systems in India can broadly categorized into three systems comprising of (i) small scale & landless farmers possessing 2-4 animals feeding on common property resources and home grown or purchased agricultural by-products, (ii) semi commercial dairy systems comprising of better breeds and feed inputs located around towns/per urban areas and (iii) fully developed commercial farms with animals having high genetic potential and scientific feeding and management.

First two categories of dairy production systems comprise almost 95 -98% of the dairy production systems in India and the share of fully developed commercial farms is a very small proportion. The nutritional strategies to augment milk production vary with the production system, resource availability and genetic potential of the animals. Some of the promising nutritional strategies relevant to India dairy sector that can be adopted for achieving targeted milk production of 300 million tons are as follows:

Compound Cattle Feed

Traditionally most of the dairy farmers use either home formulated mixture of concentrate ingredients or individual concentrate ingredients in different combinations to feed the productive milch animals. The choice of ingredients is mostly subjected to local availability or cost considerations rather the nutrient content. In majority of these cases the, diets are imbalanced leading to loss of productivity, inefficient nutrient utilization and under or over feeding. A good quality compound cattle feed is scientifically formulated using proper combination of energy, protein, mineral and vitamin supplements to deliver nutrients as per the productive needs of the animals. Usage of compound cattle feed in India is low relative to the volume of milk production. Although we don't have correct quantities of compound cattle feed used in dairy sector, as per the All Tech Feed survey India produced a total of 43.4 million tons of compound feed in the year 2022 and the share of cattle feed is around 12 million tons compared to the 26 million tons of poultry feed. Compound feed usage in dairy sector is less than the 10% of the minimum actual estimated potential feed use. With the gradual transformation of the dairy sector the usage of compound cattle feed should be encouraged as this will ensure better productivity, optimum resource utilization, better economics and health of the animal. Quality control of

* This paper was published in the Souvenir of 50th Dairy Industry Conference held during March 4-6, 2024 in Telangana.

Table 1: Projected Changes in Milch Population and Productivity for Targeted Milk Production of 300 Million Tons

Categories	2022-23			2027-28		
	Numbers (000)	Productivity (kg/d)	Contribution (%)	Numbers (000)	Productivity (kg/d)	Contribution (%)
Cattle:						
Desi	37155	3.44	20	40422	4.04	20
Crossbred	23408	8.55	32	32693	9.48	37
Buffalo	46686	6.06	45	50468	6.71	40
Goat	41928	0.5	3	48654	0.53	3

compound cattle feed is another important issue that needs to be monitored and enforced strictly to build consumer confidence and check adulteration with inferior materials.

Ration Balancing

Unlike poultry layers and broilers that have a common diet, in dairy cattle each animal is distinct and has different requirements commensurate with body weight, milk production and physiological stage. The ration of dairy animal is a mixture of dry fodder, green fodder and concentrate and the total nutrients supplied by all these resources should match the animal's nutrient requirement for maximum productivity. Under field conditions it is very difficult to balance rations to fulfil the nutrient requirements and generally feed allocation is dictated by the local availability of resources and traditional knowledge that has been passed over the generations. Multiple feed surveys across different regions in dairy animals have proved that the ration offered to dairy animals is imbalanced resulting in loss of productivity, health and reproductive disorders. Ration balancing involves selection of different ingredients in known quantities to deliver the desired level of nutrients-energy, protein, minerals etc., at least cost to match the nutrient requirement of the animal leading to optimum production, health and economics.

National dairy Development Board (NDDDB) successfully implemented the ration balancing program across 18 major milk producing states covering around 30 lakh animals resulting in multiple advantages like reduction in feeding cost, increased income and milk, increased lactation length and reduction in methane. To make the ration balancing advisory accessible to large number of dairy farmers a mobile app- "pashu poshan" has been released by the NDDDB. Similar softwares have been developed by other agencies also but the extent of their use and utility is not known. Given the wide distribution and diversity of the dairy sector and the rampant imbalanced feeding, there is a need to popularize this approach in a more intensive way to cover larger proportion of dairy farmers as this

intervention can bring in a substantial change in the way dairy animals are fed using locally available feed resources and improving the income of the farmers and overall health of the animals. Dairy cooperatives, private dairy sector, animal husbandry departments and development agencies can promote its wider adoption.

Bypass Nutrients

Rumen fermentation is an efficient system that converts fibrous crop residues into useful volatile fatty acids and microbial protein that are utilized by the animal for production of milk and meat. In high producing animals the microbial protein supply is insufficient to support high milk production and bypass protein is recommended to supply the additional protein. Bypass protein refers to protein fraction of the feed that remains inert in the rumen and is digested post-ruminally and used more efficiently for milk/meat production. Methionine (Met) and lysine (Lys) have been recognized as the first limiting AAs for lactating dairy cows under most feeding practices. Both AAs are necessary in ruminant diets for the most precise feeding to achieve the maximum production performance without overfeeding protein. With increasing feed costs and milk production costs precision nutrition with low crude protein balancing the amino acids like methionine and lysine can improve metabolizable protein utilization leading to higher production and better health and added advantage of lowered nitrogen excretion and safeguarding the environment.

High yielding animals in early lactation are in negative energy balance and negative energy balance leads to several negative outcomes like decreased milk production, delayed conception, lowered lactation yield and metabolic disorders. Supplementing fats/oil to fulfill the energy demand of the animal interferes with rumen fermentation. Bypass fats are rumen protected fats that does not affect the fiber digestibility but are digested in the abomasum at acidic pH. Bypass fats are supplemented during the first 2-3 months of lactation and they help in improving the milk yield, reproductive efficiency improved health and overall productivity and productive life of the animals.

Total Mixed Ration (TMR)

In TMR all the ingredients (roughage, concentrate and supplements) are mixed and offered to the animal. This enhances the digestibility of roughages, reduces the nutrient loss and results in increased rumen microbial protein synthesis and thereby improve the productivity and profitability. Preparation of TMR consists of roughage/forage, concentrate and other supplementary nutrients in required proportion are made into uniform mixture either in the form of mash or pellets/blocks (complete feed). Crop residues, fibrous fodders and unpalatable but nutritious unconventional feed ingredients can be effectively used in total mixed ration. Preparing TMR or complete feed requires machinery (grinder and mixer), which involves investment and cannot be taken up individually. These are to be installed on community level usage basis involving Cooperative milk societies and self-help groups can play an important role in successful implementation of this technology.

Complete Feed/Fodder Block

A complete feed block is a densified material containing either dry roughage alone or with concentrate in desired ratio to meet the nutrient requirements for a production purpose. Complete feed block based feeding is advantageous over traditional mash form of feeding as it can reduce the cost of labor, transportation, storage and ensures uniform supply of nutrients for optimum rumen fermentation. Feeding complete feed block is known to enhance the growth and milk yield. This technology is useful to transport feed / fodder to scarcity and hilly regions. This is one of the greatest ways of improving the utilization of locally available feed ingredients. In addition to this, agro-industrial by-products and non-conventional feedstuffs can be incorporated in complete feed block. Currently this technology was tried in few states but it has not been very successful due to the higher cost of the complete feed blocks. However in future considering the rising demand for balanced feeds and costs of the feed ingredients, crop residues, labour and transport costs, it is likely that this technology may work out cheaper.

Strategic Supplementation of Limiting Nutrients - Strategic Supplementation

This has been one of the most widely practice in feeding of livestock in most of the developing countries mostly necessitated by the limited availability of feed resources. Traditionally most of the dairy animals are fed on crop residues and grazing and supplemented with locally available brans, oil cakes, husks etc., to support the milk production in an economical way. However over the years due to changes in the availability of grazing resources and improvement in genetic potential of the dairy animals traditional feeding practices are no longer able to support the milk production. There is a need to

approach the concept of strategic supplementation in a scientific way considering the energy, protein and mineral requirements vis-a-vis the available feed resources.

Micronutrients

Majority of the infertility and low immunity problems in dairy animals have been attributed to the deficiency and/or imbalances of micronutrients, particularly trace minerals like Cu, Zn, Mn, and Co. Providing area-specific mineral mixture (ASMM) based on the deficiency of minerals in soil, plant and animals in different agro-climatic zones are most appropriate and cost effective method of mineral supplementation. Research conducted at ICAR-NIANP, state agricultural Universities and dairy cooperatives across different regions have shown improvement in reproductive efficiency and health in crossbred cattle under field conditions supplemented with ASMM. Chelated trace minerals are considered as special supplements during the period of high production stress and immune-compromised status. In geographical areas of acute trace mineral deficiency, part of the inorganic minerals can be replaced with chelated ones. Research on nano minerals for improving bioavailability is gaining importance.

Fodder

Fodder is a vital component of dairy production. The area under green fodder cultivation in India has remained static over several years, however with the commercialization of dairy sector in recent years the area under fodder cultivation has increased marginally (4.5 to 5.5%). Given the limited scope for expansion of area under fodder cultivation, the only means of improving fodder availability is through introduction of high yielding fodder varieties, suitable cropping systems incorporating fodder crops in food and cash crop systems on rotational basis, cultivation of fodder on degraded lands and common property resources. Greater extension efforts through KVKS, NGOS and animal husbandry department with demonstrations, timely supply of root slips/seeds, stem cuttings of improved fodder varieties with incentives for cultivating fodder should be taken up on high priority to improve the fodder availability. Some of the approaches to enhance fodder availability are as follows:

- **Promotion of drought tolerant, multi-cut forage varieties:** Crops like sorghum and bajra can tolerate low rainfall conditions better. The new improved perennial varieties of sorghum like CoFS-29 and CoFS-31 are tolerant to drought as well as temporary water-logging conditions. These varieties can give at least 2 cuts even under rainfed conditions, if sown in early part of June. Once established, these two varieties can produce green fodder for at least 3 years. Similarly, in case of pearl millet, Baif bajra-1 variety performs well in dry lands and gives 2 or 3

cuts for green fodder. The other merit is that it is a dual purpose variety and so, after taking one cut for fodder, it can be allowed to mature to provide 10 to 12 quintals of grain along with 30 quintals of stover per hectare. BAIF, a prominent NGO of India, reported improved green fodder production with baif bajra-1 at several locations in Maharashtra.

- **Replacement of old fodder varieties with new high yielding varieties:** Under irrigated conditions, several dairy farmers in Karnataka were cultivating the old variety of hybrid Napier bajra, NB-21, since long and getting about 120 tons of green fodder per hectare in 6 to 7 cuts per year. Stem cuttings of better varieties like Co-3, Co-5 and Sampoorna were distributed and the farmers were encouraged to try them across the state by NIANP, IGFR Southern Regional Research Station, Dharwad and several KVKs. By adopting these varieties, the annual green fodder production improved by 33% to over 160 tons per hectare. Similar exercise was taken up by ILRI with the support of ICAR-NIANP under the project on 'Feed and fodder production in different agro-climatic zones and its utilization for of Odisha' during 2017 and 2018. Sampoorna variety performed exceedingly well across Odisha state.
- **Promotion of fodder trees:** Providing top feeds from the trees will help to bridge the deficit of green fodder. They are hardy, perennial and ensure year-round availability of feed material for the livestock. In dry regions, their utility is much more vital. Trees like Sesbania, Subabul, Gliricidia, Melia etc. perform well even in dry lands. The normal farmers' practice of lopping only the side branches, and allowing the uninterrupted growth of main stem, reduces the yield. Instead, main stem is to be pruned to a height of 5 feet when the trunks of fodder trees are about 1.5 to 2 inches in diameter. After the first lopping, subsequent harvests can be done at an interval of around 60 days. Improved performance of dairy animals as well as small ruminants with the top feeds was noticed in several villages under the improved livelihood program of National Agricultural Innovation Project (NAIP), funded by the World Bank
- **Silage:** Silage refers to the green fodder conserved through natural pickling process, in which lactic acid is produced under anaerobic conditions by fermentation of sugars present in forages. Oxygen-free environment and lowering of pH are essential to preserve the quality during storage. Fodders which have thick stem and more sugar content like maize and sorghum are well suited for silage making. The fresh fodder harvested during grain filling stage with desired moisture content of 65-70% is chaffed. Adequate compaction is required while filling the

chaffed fodder to remove air for ensuring anaerobic fermentation. Maize is the most preferred crop for making silage due to its high yield, ease of cultivation, relatively constant nutritional value and presence of higher content of water-soluble carbohydrates for lactic acid fermentation. Making silage is one of the best practical methods for conservation of surplus forage during the flush season, as there is a great demand for quality silage in the lean season across several states in India. With the availability of improved machinery like seed drills, pneumatic planters, single or multi row harvesters, balers, etc., silage making has become less labour intensive and easier for adoption. It paved the way for entry of several silage manufacturers to promote contract cultivation of maize in several states and using that forage to make silage bales for marketing across India. The production of silage is increasing in states like Punjab, Haryana, Telangana, Gujarat and Maharashtra. For example, as per a rough estimate, over 35 lakh tons of maize silage was produced in the state of Punjab during 2022. Small scale farmers can adopt the drum silage. The drums are most durable and easy to handle. 105 to 110 kg of silage can be made in each drum of 200 liter capacity. Small dairy farmers purchased 8 to 10 plastic drums, prepared 800 to 1000 kg of silage and ensured adequate green fodder feeding during the summer months. Feeding of 4 to 5 kg of silage to a lactating cow (in addition to traditional practice of dry fodder + concentrate) during the summer months improved milk yield by 0.8 liters per day. The field testing revealed that, with silage feeding for 4 lean months, the net profit per cow will be over Rs. 1500. After the adoption of this technology, the quantum of milk procurement by dairy society did not slump even during the summer season.

Alternate Feed Resources

Given the shortage of conventional feed resources, there is a need to promote the use of alternate feed resources to augment feed supply and reduce the feeding cost. Major limitations of alternate feed resources are that they are available in smaller quantities, seasonal and sometimes they have anti-nutrients that restrict their usage. A variety of alternate feed resources like distillers grains, brewery waste, vegetable/fruits waste, rain tree pods, guar seeds, hydroponic fodder, azolla, spineless cactus, areca sheath, maize cobs/sheath, sugar cane thrash etc. are available in different regions and they can be used locally to bridge the feed deficit.

Conclusion

Major problems associated with feeding livestock for optimum production is shortage of feed resources specially concentrates high proportion of crop residues

OPINION

and imbalanced feeding. Crop productivity for most of the cereals, pulses and oilseeds in developing countries are low and improving the crop productivity through better varieties and crop management (fertilizer application, irrigation and pest control) can substantially improve the feed resources availability through crop residues and by-products like bran, husk and oil cake and can contribute to narrowing the feed deficits. Crop residues are the major feed resources and any attempt to improve its utilization either through dual purpose crops or strategic supplementation can help in improving the livestock productivity. Current feeding practices especially in ruminants fail to exploit the existing genetic potential due to imbalanced feeding and ration balancing or strategic supplementation provides an option to balance the ration using the available feed resources in economical and efficient way leading to better productivity. Feeding strategies in isolation would not be able to bring about the desired effect as it needs to go hand in hand with the breed improvement, health management and the whole ecosystem of dairying sector needs to gear up to promote dairy on commercial lines ensuring that the producers get the right price for their produce. Given the diversity of the dairy production systems the feed strategies needs to be adopted/ refined to suit the local conditions. Demand for feed resources are growing at a faster rate than the supply side and these calls for efficient utilization of the existing feed resources, minimize the wastage and prevent the diversion of resources to non feed uses. Feed

management strategies should be strengthened with the herd management practices to achieve acceptable performance parameters like age at first calving, inter calving interval, lactation length, minimum productivity figures all of which would ensure that available feeds are used in the most productive way without any wastage.

Authors

S.Anandan
ICAR-National Institute
of Animal Nutrition and
Physiology, Bengaluru
anandsrp@yahoo.co.in



N.K.S. Gowda
ICAR-National Institute
of Animal Nutrition and
Physiology, Bengaluru



K. Giridhar
ICAR-National Institute
of Animal Nutrition and
Physiology, Bengaluru



JOIN 51st DAIRY INDUSTRY CONFERENCE

The 51st DIC is scheduled to be held during March 6-7-8, 2025
at Samrat Ashoka International Convention Centre,
South Gandhi Maidan, Patna (Bihar). The theme of the DIC is
"Indian Dairying : Global Growth; Local Strength."

For Online Delegate Registration, visit <https://51dic.in> or use the below link:
<https://51dic.in/delegate-registration>