Judicious Use of Available Feed Resources for Increasing Net Daily Income of Dairy Farmers

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Introduction

Feed constitutes more than 70 per cent of the cost of milk. No breeding program can succeed unless improved animals are given adequate feed, fodder, nutrients and mineral supplements. Most animals are underfed because India has shortage of feeds and fodders. At present, the land under permanent pastures and grasslands is about 3.6% of the geographical area and the fodder cultivation is limited to only to 4.86% of the cultivable land. To increase production of crop residues, there is need to develop new varieties of seed of crops that produce more dry fodder without decreasing per acre yield of grains. Despite the legal ban, crop residues are continuing to be burnt. To avoid burning of leftover, there is need to develop automatic harvesters that can harvest both the grain and residue. Shortage of green fodder is because of the lack of availability of good quality fodder seeds in adequate quantity. Perhaps, there is smuggling into India of fodder seeds. It is suggested that the fodder seed production should be a part of the Department of AH & D rather than the agriculture. National Seeds Corporation should be given targeted responsibility to produce quality fodder seeds. Various additives in feed such as enzymes, probiotics, single-cell proteins and antibiotics, are already being used widely in intensive production systems worldwide to improve the nutrient availability and utilization of feeds and the productivity of livestock. There is need to produce these indigenously in adequate quantity.

Against a total requirement of over 120 million tonnes of feed every year, the feed manufacturing facility is limited to about 8 million tonnes. There is a need to raise installed cattle feed plant capacity as well as plant utilization capacity. Also, there is a need to increase number of mineral mixture plants and strengthen quality control laboratories. Newer feed technologies such as total mixed rations, complete feed technologies, bypass protein and bypass fat technologies must be brought into practice. For improving productivity and productive life, it is important that the calves born are healthy and reared on scientific lines so that they attain early maturity and start producing milk at an early age. To address this, there is a need to initiate calf rearing programme for female indigenous cow and buffalo calves under field conditions on large scale.

Supplementing minerals and vitamins for improved productivity: Minerals and vitamins are essential for growth, production and reproduction and are involved

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in a large number of digestive, physiological and bio-chemical processes within the body. Minerals and vitamins deficiencies may result in delayed onset of oestrous, repeat breeding and/or infertility. Impaired reproduction performance results in an increased inter-calving period, causing great economic loss to the dairy farmers, which is often unrealized. Infertile dairy animal means a loss in milk production and profitability from dairying. Productivity of dairy animals can be improved by reducing inter-calving period and curing anoestrus animals through supplementation of minerals and vitamins. For lactating dairy animals, supplementation of trace minerals and vitamins, go beyond correcting for deficiency, but are aimed rather at minimizing stress and optimizing production efficiency. Free radicals can be extremely damaging to biological system. However, these oxidative products can, in turn, damage healthy cells if they are not eliminated from the body of animals. Some vitamins and minerals, which act as antioxidants, serve to stabilize these highly reactive free radicals, thereby, maintaining the structural and functional integrity of cells. Thus, supplementation of minerals and vitamins are very important to immune defence, production, reproduction efficiency and health of animals.

In India, dairy animals mainly thrive on crop residues, supplemented with limited quantity of green fodder/ local grasses, and cattle feed and/or concentrate feed ingredients. Crop residues based diet is poor in the essential minerals. It also contains several anti-nutritional factors like silicates, oxalates, gossypol and phytates, which further inhibit their utilization. Under such feeding regime, it has been found that a large number of dairy cattle and buffaloes suffer from reproductive disorders, which are primarily due to micro-nutrients deficiencies. About 50% of the minerals for various physiological functions are available to the animals from feeds and fodders and remaining 50% are supplemented in the form of mineral mixture. If mineral mixture is supplemented @ 50-60 g for dry animals and 100-200 g for milch animals (not fed cattle feed), then daily feeding cost of mineral mixture would be about ₹ 5-10 per animal. With this little input cost, reproduction efficiency of animals can be improved significantly, which can help in increasing the productive life of animals.

Dietary cation-anion balance (DCAB) for preventing milk fever: Milk fever can be prevented by balancing dry animal rations for anions and cations. Na and K are the cations and chloride (Cl) and S are the anions of interest in formulating anionic diets. The DCAB equation most often used to determine milli-equivalents per 100 g of dry matter is: mEq /100g = mEq (Na + K) - mEq (Cl + S). Based on current research, the range that achieves the lowest incidence of milk fever is a DCAB of -10 to -15 mEq/100g dry matter (DM). Achieving a DCAB of -10 to -15 mEq/100g requires adjustments in the major mineral levels that are quite different than what is normally supplemented for regular dry animal rations. Acidic salts (ammonium chloride, calcium chloride, magnesium chloride) affect the animal's acid-base status, raising the amount of Ca available in the blood. Urine acidity is affected by these changes in the animal's acid-base status. Checking urine pH can help milk producers and veterinarians to monitor the effectiveness of an anionic ration

Bypass protein supplement as a source of bio-available amino acids: Usually, oilseed meals/cakes are fed as such to ruminants in India, which have varied degree of naturally rumen protected proteins. The solubility of proteins does change when subject to special treatments, and it could be exploited to protect good quality proteins from rumen degradation. Formaldehyde treatment of protein meals for production of bypass protein supplement is cost effective technology for protection of highly degradable proteins in rumen, without having any adverse effect on the animal's health and on milk quality. Regionally available oilseed meals are treated suitably, so as to reduce degradability of the proteins in the rumen from 60-70 to 25-30%, in a specially designed airtight plant. Protein meal identified for treatment is first processed through hammer mill keeping particle size 1-2 mm size, treated chemically at appropriate level and then stored for 9 days under airtight conditions. After 9 days of incubation period, oilseed meal is ready for feeding to ruminants and it can be stored for more than a year, without any deterioration in quality. Treated oilseed meals can be either fed directly to animals as top feed @ 1-2 kg per animal per day or else, treated meals can be incorporated in cattle feed @ 25-30% and this bypass protein feed can be fed @ 4-5 kg/ animal/day, depending up on the level of milk production. The cost of treating oilseed meal is between ₹ 3.0 and ₹ 3.5 per kg.

Studies conducted on feeding one kg treated meal in comparison to untreated revealed that there was increase

in daily milk production by more than 1 litre and milk fat increased by 0.3%. Scientific studies conducted on bypass protein supplement revealed that the feeding of bypass protein to growing animals increased growth rate (25-30%), which resulted in reduction in rearing cost and in attaining early maturity of the calves. It has also been shown that bypass protein feeding improves the reproductive efficiency.

Bypass fat supplement for increasing energy density of ration

Most of the dairy animals, especially high yielding animals suffer from energy deficiency, as they are not fed adequate grains, good quality cultivated fodders and other energy rich supplements. There is heavy loss of body weight of high yielding animals after calving as the energy intake is less than the requirement to meet the demand for milk production. Majority of field animals thus suffer from negative energy balance (NEB), which reduces not only milk production but also the reproduction efficiency. As a consequence of NEB, animal mobilises body nutrient reserves, particularly body fat, to meet energy demand. The negative energy balance in early lactation causes delayed post-partum ovarian activity, apart from affecting peak milk yield and also lactation yield. The high yielding animals, therefore, in early lactation should be fed either higher level of cereal grains or fed on diet supplemented with bypass nutrients to meet their energy requirement. However, since excess of cereal grains in the diet can cause rumen acidosis predisposing the animals to ill health, and drop in milk yield feeding bypass nutrients becomes better option.

Considering its energy density, fat is a logical choice for boosting ration energy density avoiding the detrimental effects of feeding high level of grain. Rumen bypass fat can be fed without affecting fermentation in the rumen, fibre digestibility and is highly digestible post-rumen. Moreover, supplemental fat in protected form has special significance in the diets of dairy animals with higher productivity, because the high energy density of fats allows greater energy intake and direct transfer of fatty acids of the supplemental fat to milk fat; thereby, increasing metabolic efficiency. Feeding bypass fat @ 150 to 200 g/day to high yielding cows and buffaloes during the transition period (30 days and 90 days after calving) could help improving their body condition scores, milk production and reproduction efficiency. Bypass fat can also be incorporated in calf starter @ 2% for higher daily weight gain and early age at maturity in young calves.

Improving nutritive value of crop residues: Availability of crop residues is uneven, with some areas having a surplus and others facing a perennial shortage of dry fodder. Regional imbalances and shortages of crop residues lead to a) sub-optimal livestock productivity due to imbalanced feeding and b) significant costs on account of transporting low bulk density residues across large distances. Loss in productivity is irreversible at times and the net profitability of livestock owners is greatly affected due to this phenomenon, thus, there is a need to manage feed and fodder resources efficiently during this period, with value addition. Even though crop residues are sold at a premium (₹ 6 per kg and more) in deficit and drought prone regions, they are often burnt in surplus areas. Crop residues that are enriched and compressed in the form of blocks, pellets, briquettes etc. can be transported at lower cost from the surplus to deficit regions. Some of the existing infrastructure can be utilized for the production of straw based pellets, blocks etc., without any additional investment.

Mowers for crop residue recovery from combine harvested fields: Crop residues form the main basal diet for cattle in India. Due to labor shortage many farmers are adopting grain harvesters intensively for managing food crops like wheat rice, maize, oil seeds, pulses, resulting in huge field loss of fodder biomass which was otherwise available to dairy animals in manual harvesting system. For reducing the fodder wastage after grain combines the farmers need to introduce fodder mowers and auto pick up devices for effective recovery of straws and stovers. Mowers are high speed fodder harvesting machines having inbuilt options for chopping, crushing, trailer loading, stem cracking and conditioning as per specific needs of the biomass. They are the most economical devices for straw recovery, silage making, hay making, mulching, composting, soil incorporation and of course daily feeding. Mowers are also known as roughage management machines used for intensive fodder production for higher protein and higher energy recovery at right stage of harvesting. Depending on season, crop hardness, tenderness, thickness, height and moisture of different crops various types of fodder mowers are to be propagated in India fitting into future high speed and intensive farming systems being adopted by progressive farmers.

Straw based feed pellets: Despite shortage, lignified bio-mass such as cotton stalks, soybean and mustard straws are burnt in different parts of the country. Lignified biomass can be easily crushed and used for making feed pellets. These pellets can be transported and stored at strategic locations and used during scarcity or during natural calamity as a complete ration. In view of this, straw based feed pellets using 50% cotton stalks and 50% concentrate feed ingredients were prepared on a pilot scale and tested on lactating cows.

Straw based feed pellets were found to be palatable to dairy animals and the daily feeding cost reduced significantly in animals fed on cotton stalk, soybean and mustard straws based feed pellets.

Green fodder production enhancement: Green fodder is an economic source of macro & micro nutrients for the livestock. It is highly palatable, digestible and rich in minerals and vitamins and helps in improving digestion of crop residues under mixed feeding system. Therefore, production and availability of quality green fodder round the year in sufficient quantity is crucial for economic milk production. The shortages of quality green fodder is mainly due to low green fodder yield of cultivated fodder crops, poor utilization of fodder coupled with lack of awareness about improved fodder production & conservation technologies among farmers. Moringa (*Moringa oleifera*) is a multi-purpose tree having potential to produce nutritious and palatable green fodder all-round the year like any other multi-cut fodder crop. It contains around 18% crude protein, rich in minerals and vitamins. Providing technical support to the dairy cooperatives to introduce and popularise Moringa cultivation among farmers for supply quality and nutritious green fodder to milch animals is great help. Proper and efficient utilization of green fodder so produced is important to enhance the availability of fodder. Feeding chaffed fodder to livestock reduces wastage of fodder up to 40%.

Further, surplus green fodder produced during any season needs to be conserved to minimise wastage and for use during the lean period. Silage making is the best practice to conserve green fodder of cereal fodder crops, rich in sugars. Silage making include harvesting of crop at 30-35% dry matter (grain formation to dough stage) followed by chopping in 2-3 cm pieces and storing in a silo pit under anaerobic conditions for a minimum period of 45 days, after proper packing and sealing. Silage can be fed to animals as a substitute of green fodder. It ensures supply of fodder of consistent quality during the lean period.

Optimizing feed utilization efficiency by balanced feeding: The economy of dairy feeding and the environmental foot print of dairy production demand an optimal fit between ration composition and dairy animal requirements. Ration balancing presents a greater challenge in more extensive dairy systems such as in India, still the largest dairy producer. For one, feed resources are generally more constrained and in India crop residues present the single most important feed resource while concentrate availability is quite low. In addition, feed resourcing and feeding is often very opportunistic making consistent ration design and ration offering difficult. Three key elements of ration balancing and ration design – matching protein and energy content of the ration with actual milk production, economic feed substitution and the importance of mineral supplementation – can be also implemented in these more extensive systems. Preparing least cost balanced rations, using available locally feed resources and area specific mineral mixtures are best option for small holding farming systems. With balanced feeding, it was possible to improve daily milk yield in buffalo and cattle between 2-14% and milk fat level between 0.2-15% while at the same time reducing in feed costs between resulting in increases in net daily income of farmers per animal from 10-15%.

Improving feed conversion efficiency (FCE) for milk production with available feed resources is of paramount importance. Balanced feeding has greater impact on FCE in cows (n=7090) and buffaloes (n=4534) under field conditions and found that ration balancing improved ($P<0.01$) FCE (kg fat corrected milk/ kg DMI) from 0.61 to 0.74, 0.79 to 0.90 and from 0.80 to 0.91 in indigenous cows, crossbred cows and buffaloes, respectively. Thus, through balanced feeding, it is possible to increase FCE for milk production in cows and buffaloes, i.e., to produce more milk per kg dry matter intake. Balanced feeding has not only resulted in higher net daily income of farmers but also in reduced carbon footprint of dairy production. To quantify the impact of balanced rations on CH_4 emissions, studies conducted in different agro-climatic regions of the country showed that balanced feeding reduces CH_4 emissions (g/kg milk yield) by 17.3% ($P<0.05$) and 19.5% ($P<0.01$) in lactating cows and buffaloes, respectively. Balancing of protein,

energy and minerals shifted the rumen fermentation pattern towards higher microbial efficiency, capturing feed carbon for microbial biomass production rather than SCFA production, thereby, reducing CH_4 emissions. A cradle-to-farm-gate life cycle assessment (LCA) study indicated that after feeding a balanced ration, average carbon footprint of milk reduced ($P<0.01$) from 1.6 to 1.1 and 2.3 to 1.5 kg CO_2-eq/kg fat and protein corrected milk in cows (n=1,63,540) and buffaloes (n=1,63,550), respectively. Emissions of CH_4 from enteric fermentation, CH_4 from manure management, N_2O from manure management contributed 69.9, 6.3 and 9.6% in cows; and 71.6, 7.4 and 12.6% in buffaloes, respectively, to the baseline lifetime total greenhouse gas (GHG) emissions. Present LCA indicated that, the CH_4 from enteric fermentation is the largest contributor to the total GHG emissions in smallholder dairy production system of India.

Future plans for advanced feeding of dairy animals for increasing farmers' income

- Providing ration balancing advisory services to all categories of animals.
- Challenge feeding for elite animals.
- Production and supply of chelated area specific mineral mixtures.
- Calf rearing programme for indigenous cow calves and buffalo calves.
- Fertility improvement through supplementing critical nutrients for anoestrous and repeat breeding animals.
- Production of different variants of cattle feeds for various categories of animals.
- Production and supply of bypass protein/fat supplements for improving milk production efficiency.
- Summer feed for combating heat stress and improving milk production.
- Securing crop residues in surplus areas using mowers and production of straw based feed pellets using lignified biomass.
- Making availability of truthfully labelled/certified fodder seeds for improving fodder yield from the land available under green fodder production.
- Popularization of Moringa as a nutritious fodder crop.
- Promotion of thornless cactus in arid and semi-arid zones as a source of green fodder.