

**Review Paper**

Strategies for Improving Feed and Fodder Production and Utilization for Enhanced Milk and Meat from Livestock in India— A Review

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Abstract

India with 328.73 million hectares geographical area is endowed with diverse livestock (485 million) wealth. Currently, India is the largest milk producer in the world with 105 million metric tons per annum. Despite this, there is deficit of milk and meat to meet the recommended daily allowances (RDA) of milk and meat consumption for human. Hence, there is need to enhance livestock production. The main constraints in improving the milk and meat production from livestock are low genetic makeup of indigenous livestock and insufficiency of feed and fodder resources for livestock feeding. The Government of India has initiated several research projects to enhance feed utilization. To meet the gigantic and challenging task of feeding the livestock with the quality forages, there is definite need to increase forage production per unit area through encouraging high yielding fodder crops and forages, in mixed crop-livestock farming systems. General strategies for utilization of available crop residues and non conventional feed resources (NCFR) are by proper storage, processing, harvesting at right time, beside conservation and judicious usage. Nutritional strategies are the development of complete rations for effective utilization of feed resources. Compressed feed blocks and use of expander-extruder processing of complete feeds is another strategy. Development of package of practices by strategic supplementation of specific deficit of nutrients at catalytic level is another strategy. Feeding of by-pass proteins and by-pass fats in the rations of high yielding cross bred cows is alternative strategy. Use of bio- technological products, like pro-biotic, pre-biotic and parental application of bovine somatotropin for dairy animals can dramatically change the milk and meat production status. On long term basis, these strategies will have potential to ensure the sustainable availability of feed and fodder resources and their effective utilization for enhancing milk and meat production from indigenous livestock.

Key words: Feed and, Fodder, Livestock feeding strategies, Milk, Meat production.

Introduction

India is endowed with the most fabulous diverse live stock wealth in the world. The country has 215 million cattle, 98 million buffaloes, 124 million goats, 61 million sheep and 13.5 million pigs. (total 485 million livestock population) and makes up 12% world livestock population (FAO, 2006). Indian cattle, buffaloes, sheep and goat constitute about 14, 58, 6 and 16 % of the world livestock population, respectively. (Table-1: Fig-1). India ranks first in buffaloes and goat population in the world.

Table 1. Human and livestock population (in millions) (FAO, 2006)

Population	India	Position in the world	Annual growth rates (1997-2003%)	World
Human	1000.9	-	-	-
Livestock				
Cattle	215	-	-1.18	1350.9
Buffaloes	92	I	1.43	170.3
Sheep	58	VI	1.12	1038.7
Goats	123	I	0.22	771.5
Pigs	16	-	0.28	941.5
Total	504	-	-	4401.6

Dynamics of livestock population and annual growth rate trends (1997-2003) indicates that there is a positive trend in the annual growth rates of buffaloes (1.43%), sheep (1.12%), goats (0.22%) and pigs (0.28%), while negative trend was observed in annual growth rate trends of cattle (-1.18%).

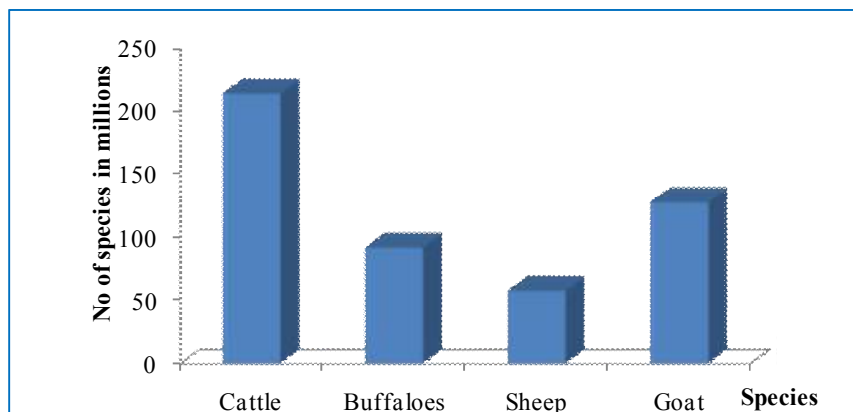


Fig. 1. Livestock wealth

Buffaloes and goats are the animals for the country for poverty alleviation program me. With regard to the cattle population, there is a clear shift of preference towards high yielding animals. Cross bred cattle population has increased by 22.8% and indigenous cattle population decreased by 10.2%. There is also increase in female cross bred population and male population by 34% and 12.3%, respectively. These trends were reflected in the milk production at 97.1 million metric tons in 2005-06 which is 4.97 % more than that in 2004-2005.(Reddy,D.V.,2011).

Table-2. Milk production (Million metric tons/ANNUM) IN INDIA(FAO,2006)

	India	Andhra Pradesh
Cow milk	36	1.09
Buffalo milk	38	3.13
Goat milk	3.18	-
TOTAL MILK	77.18	422

In India, out of total milk production 49% is contributed by buffaloes, cows contribute 47% and contribution from goats is 4% (Fig-2).

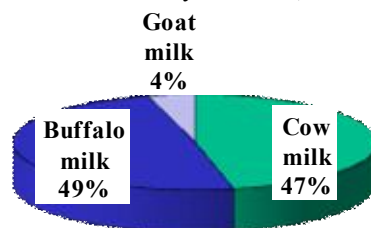


Fig. 2 Augmentation of milk production in India.

Livestock production and rural economy

In India, 70-80% of the total livestock produce is contributed by the landless marginal farmers and small land holders, who are underprivileged (Kurup, 2004).Livestock are important assets for rural people and play crucial role in building their livelihood.. For household security in small holder farming system animals and livestock play a critical role

Animal products vs plant products

Animal products are inevitably costlier compared to plant products, due to double conversion of basic food constituents, apart from cost of processing of by-products into feeds..Soil nutrients are firstly converted into plant products, which upon feeding to animals later are converted into animal products. Example of double conversion is that the average efficiency of conversion of fertilizer nitrogen into plant protein is 50%,where as the average efficiencies of conversion of plant protein into animal protein is approximately 25,26,23,11, and 4% for milk, egg, broiler chicken meat, pork and beef or mutton, respectively.

Justification for enhancing livestock production in India

Human beings are omnivorous and majority are willing to pay higher prices for foods of animal origin, as they prefer mixed diets. Animal products, even in tiny quantities, support physical, intellectual development of children and pregnant mothers. The consumption of meat, milk fish and eggs contributes to meet amino acid and trace mineral requirements of human population, has a considerable enjoyment value and are indicators of living standards. Live stock rearing facilitates recycling of nutrients (soil-plant-animal-soil) and reduces environment pollution as well as enhances the additional profits from the livestock enterprise.

Mixed crop- livestock farming contributes to stability and sustainability'. Stability is promoted by keeping of animals which serve as a form of insurance. Sustainability is promoted because of mixed crop –livestock system which is environmentally most

desirable system. Livestock proved to be a crucial link in nutrient recycling on small farms, maintaining viability and environment sustainability of agricultural production. Intensive integrated mixed farming system has a agricultural, aquaculture and livestock farming systems, involves intensive use of all biological resources of the farm to optimize the farm productivity per unit of soil, water, and air. In India the prevailing and predominant system is integrated mixed farming system.

Availability vs requirements of animal products

In the last 25 years (1978-2003), the proportion of dietary calories coming from livestock products (milk, meat and eggs) in developing countries, like India, has increased from 6-10%. In developed countries the proportion remained constant at 20%. There is definite demand for animal products in the country leading to livestock revolution, which is a consumer driven or demand driven. Production potential of livestock in India is very low as compared to livestock in developed world because of poor genetic makeup: For example in India the average milk production from cattle and buffaloes will be 500-520 Kg/animal in 300 d. Of lactation, where as in developed countries, milk production potential is 4000-6000 Kg /animal in 300 d. Lactation. Poor management and health care. The most important one is inadequacies of feed and fodder resources

Table 3. Meat production (million metric tons) in India (FAO, 2006).

Beef and veal	1.41
Buffaloes meat	1.41
Mutton and lamb	0.228
Chevon	0.446
Pork	0.409
TOTAL	4.400

Per capita consumption of meat in India is 1,3 Kg per head per annum. Requirement of meat as per standards is 6.57million metric tons as against availability of 4.4 million metric tons. In India carcass weight of sheep and goat is 10 K g each, as against 25 Kg in developed countries, This is because sheep and goat are not reared for meat purpose.

Feed supply system for livestock

Feed is an important input for milk and meat production and constitutes 50-70% of total cost of livestock products. While milk production in India is increasing fast (India is largest producer of milk in the world with 105 million metric tonnes, FAO, 2006), the feed and fodder resources are depleting very fast due to increase in human population, urbanization and pressure on land to grow cereal crops. This led to qualitative and quantitative insufficiency of feed and fodder resources for livestock consumption, which is the main impediment of livestock industry development in India.

Table 4. Vis-a-vis, comparison and deficit between and requirement and availability.

NCA ,(1976)	Roughages	Green fodders	38%,deficit
		Dry fodders	40% deficit
	Concentrates		44% deficit
Ranjhan (1994)	Roughages	Green fodders	38% deficit
		Dry fodders	
	Concentrates		47 % deficit
NIANP (2002)	roughages	Dry fodders	44% deficit
		Green fodders	45%deficit
	Concentrates		38% deficit

The latest data base on availability and requirements of feeds and fodders indicates the deficit with regard to dry fodders green fodders and concentrates as 11%,28% and 35, respectively (NIANP,2005).The imbalance between the livestock population and the available feed resources associated with frequent exposure to drought or dry spells of 4-5 months in a year with virtually no green forage for garaging led to more dependence on crop residues ,AIBP and NCFR for feeding of ruminant livestock.

Measures to bridge the gap between the demand and supply of feed resources

The area under fodder crops has been estimated to be 3.3% and 4.41% of total cultivable area in India. This area is further reduced as most of the land is going to be diverted to cereal cops and oilseed crop cultivation. This results in increased crop residues for animal consumption. Several attempts /measures have been undertaken by government of India to bridge the gap between the demand and supply of animal feed resources in the country. These are:

- ✓ ICAR has initiated an AICRP on the utilization of Agricultural By products and Industrial Wastes Materials for evolving Economic Rations for Livestock in 1967 at 4 centres.
- ✓ In the V Plan 4 more centres was started.
- ✓ In the VI Plan 2 more centres were added at APAU, Hyderabad and AAU, Gauhati.
- ✓ In the VII Plan the scope of the project was expanded and the title was modified to Determination of the availability of Animal Feed Resources and Their utilization with Special Emphasis on Crop residues , by-products of Industries, Forest, Aquatic and Slaughter house in origin and Animal Organic wastes for Evolving Economic Rations for Livestock and Poultry.

- ✓ During this VII plan 3 more centres were added and project functioned at 11 centres.
- ✓ An Indo US project Conversion of Biodegradable Animal Wastes for Animal Feed was initiated and functioned at 5 centres.
- ✓ In the IX Plan the project was renamed as Net work Programme on Agricultural By-products as Animal Feeds-Complete feeds functioned at 4 centres.
- ✓ In the X Plan , the 3 net work projects were converted into ICAR- AICRP entitled Improvement of feed resources and nutrient utilizations in raising animal production at NIANP Bengaluru with 22 centres .The objectives are to address different feeding systems and livestock production systems in the country through nutritional interventions in raising animal productivity and profitability.

Availability of green fodders

Green fodder is not available as per the requirements for livestock feeding. The area under permanent pastures and other grazing lands in India is only 3.3% as against the recommendations of 8% of total cultivable area. Grazing lands are under continuous degradation due to exploitative stress, shrinking due to competing demand of cultivating food crops for meeting the demands of increasing human population due to urbanization and due to industrialization.

.Meeting the demands of quality forages to our livestock feeding is gigantic and challenging task. Only alternative is to increase the fodder production within the limited area. It is essential to improve fodder production by efficiently and effectively utilizing the available resources of land, water, and other sources for improved milk and meat production for future food security of huge population of the country.

Qualitative and quantitative insufficiencies of feed resources for livestock feeding can be achieved through multi pronged sustainable strategies. These are:

- ✓ Strategies to increase forage production per unit area.
- ✓ Encouraging forage production in mixed crop-livestock farming systems.
- ✓ Putting to good use of waste lands denuded, degraded marginal and sub marginal lands for the development of pastures and agro-forestry systems.
- ✓ Strategies for efficient utilization of locally available resources like crop residues, AIBP and NCFR.
- ✓ Representing to the government for augmentation of feed and fodder resources.

Strategies to increase forage production per unit area

- ✓ Evolving intensive fodder production systems with efficient utilization of land and other farm inputs for maximum forage production.
- ✓ Identifying improved fodder varieties on the basis of high production potential ,better quality traits ,adaptability to different agro-climatic zones and suitability to different farming situations .
- ✓ Utilizing state Agricultural. University farms, AH departments and progressive farmers for production of quality seeds for distribution.
- ✓ Developing a system for assessing farmer's needs and arranging timely supply of quality seeds. Growing improved varieties of forage crops.
- ✓ Taking up intensive forage crop sequences and/or intercropping systems for increasing herbage yield,
- ✓ improving forage quality and for year round forage production in milk shed areas Taking up intergradations of forages as mixed inter or rotation crops with the existing food or commercial crops
- ✓ Taking up grass and tree based systems like lay and alley farming for dry land areas and draught prone areas. Intercropping of legume fodders with grain crops.
- ✓ Taking up fodder production in tank beds in summer.
- ✓ Taking up forage production in problematic soils.
- ✓ Utilization of the electronic media to educate farmers through distant education about cultivation practices of various high yielding fodder varieties.

Encouraging forage production in mixed farming systems

- ✓ By inclusion of fodder crops in crop sequence.
- ✓ By growing short duration forage crops in the gap periods of main crops.
- ✓ By increasing the production of crops which provide forage as by products like sugar cane, sun hemp, cowpea, turnip, carrot, cauliflower etc.,
- ✓ By growing suitable fodder crops in fruit orchards for fodder as well as enriching the soil fertility. for example Mango, citrus, guava orchards – Anjan, Rhodes, Stylo, Siratro Coconut and Banana orchards – Pillipesara Around Vegetable orchards – 3-4 rows of NB 21, Leucaena plants Beetlenut Vine orchards – Sesbania plantation

Putting to good use of waste lands denuded, degraded, marginal and sub-marginal lands for the development of pastures and agroforestry systems

The following steps are suggested to restore the degraded grazing lands.

- ✓ Close the grazing lands from grazing for a period, Clearing off the undesirable bushes,/trees etc.
- ✓ Adopting soil and water conservation practices .Preparation of land and manuring in strips
- ✓ Introduction of improved perennial grasses like *Sehimanervosum*, *Cenchrusciliaris*

- ✓ Application of fertilize
- ✓ Introduction of desirable trees like *Acacia catecheu*, *Azadirachta indica*

Adopting improved systems of grazing like

- ✓ Continuous
- ✓ Controlled grazing
- ✓ Rotational grazing
- ✓ Differed grazing
- ✓ Differed and rotational grazing

Strategies for efficient utilization of available resources like crop residues.

Non-conventional feeds and fodders

General Proper storage of crop residues and NCFR i.e. protecting them from rain and exposure to sun will prevent wastage and improve utility to an extent of 10-15%. Chaffing green dry fodders and feeding will prevent wastage and improve utility to an extent of 20-60%. Harvesting the green fodders at optimum stage to retain maximum nutrients. Conservation of fodders during lush season and judicious usage of crop residues at farm level,

Nutritional

Formulation of complete rations for efficient utilization of nutrients. Development of low cost feeding strategies by utilizing locally available feed resources.

- ✓ *Strategic supplementation of specific deficit nutrients for intensive milk and meat production.* (Pratap Reddy and Rama prasad, 1985)
- ✓ *Catalytic supplementation of legume fodders *Leucaena fodders etc.**, (Ravi and Ramaprasad, 2005, 2006.)
- ✓ *Feeding of complete ensiled ration*

Crop residue based complete feeds and compressed feed blocks

In an effort to utilize the agro-industrial by-products (AIBP) and non conventional feed resources (NCFR) in a more intensive way. These feed resources are processed and included in complete rations at different ratios. In complete rations all the feed ingredients inclusive of roughages are processed (chaffing, grinding and pelleting) and mixed into a uniform blend that discourages selection of ingredients by animals (Rama Prasad *et al.*, (1999). Blending of coarse roughages in the form of complete feeds /total mixed rations (TMR) helps in developing low cost feeds, avoids refusal of unpalatable portion or selective feeding, and improves utilization of supplemental urea or uric acid of poultry droppings. These complete feeds provide adequate and balanced nutrients in optimum ratios of roughages to concentrates. Complete rations have a particular relevance and considerable interest and future potential, when viewed in the context of a shift towards more intensive systems of production of milk and meat in urban areas also .The CP content of complete rations varies from 12.82-13.7% and can be fed to both large and small ruminants.

Several researchers (Rama Prasad *et al* 1998, Rama Prasad and Krishna, 1992,) conducted several experiments using small ruminants by including various crop residues like ground nut haulms , grass hays etc. at different roughage and concentrate ratios and observed improved feed intake, average daily gain and DM intake per Kg gain.

Compressed feed blocks/Densified feed blocks

Densification of complete feeds reduces the volume of feed which makes its handling, storage and transportation easy..For production feed blocks, mixtures of roughages and concentrates are compressed in a machine. Dr Amar Singh and his team from IARI, New Delhi developed block making machine which has been patented..Complete feed blocks for dairy animals are available.

Table 5. Complete rations for small ruminants

Crop residues (<i>Sehima nervosum</i> hay, <i>H. Contotus</i> hay, sorghum/maize Stover. Sun flower straw or cotton straw)	25 parts
Ground nut haulms	25 parts
Wheat bran	20 parts
Maize	11-18 parts
G N Cake	9-16 parts
Mineral mixture=Salt	3 parts

Expander –Extruder processing of complete feeds

By expander and extrusion of complete feeds further improves its nutritive value. In this system combines the features of expanding (application of moisture, pressure and temperature to gelatinise starch) and extruding (pressing the feed through constrictions under pressure)The feed is conditioned to 16-17% moisture by adding water and then fed to machine. Expander and extruding processing is simple to operate with less maintenance cost and high production efficiency.

Table 6. Development and evaluation of complete rations containing some crop residues for ruminants

Fallen Banyan tree leaves	Lambs: included at 40%	Rama Prasad and Krishna (1992)
Ground nut haulms	Sheep: included at 50%	Rao A R, <i>et al</i> (1994).
	Goats: included at 50%	Rao S .B. N <i>et al</i> (1995).
	Sheep: included at 60%	Rama Prasad <i>et al</i> (2000).
	Adult sheep: at 60%	Asha rekha <i>et al</i> (2005,2006)
Legume crop residues		
Stylo, Horse gram, Cow pea, Sun hemp hays	Sheep; included at 50%	Krishnamurthy and Rama Prasad (2002, 2005). Rama Prasad <i>et al</i> (1998).
Urachunie	Sheep: included at 50%	Rao D S <i>et al</i> (1998).
Green gram chunies	Buffaloes; included at 60%	Rao D S <i>et al</i> (2000).

Table 7. Complete feed block

Ingredient	Composition%	Nutrient composition%
Urea ammoniated wheat straw.	73%	CP,8.4%
Wheat bran	10%	DCP,5.1%
Molasses	15%	TDN,58.82%
Minerals =salt	2%	ME M cal/Kg DM
Vitamin AD	3-10 g per 100 Kg	

New technologies

- ✓ Development of simple and economically viable and sustainable technology for increasing the nutritive value of low quality feeds. Urea treatment of cereal straw 4% urea, 50L water/100Kg, 7-21 d incubation.
- ✓ Specific processing techniques to reduce the amount of urea and incubation time like incubating supplementing with horse gram grain etc.,
- ✓ Use of urea – molasses – mineral blocks (UMMB)

By-pass nutrient technology

- ✓ Feeding of bypass protein sources in the rations of high yielding dairy cows more than 10l/d.
- ✓ Feeding of bypass fat in the form of ca salts of fatty acids to lactating animals for improving milk production

Use of non-conventional feed supplements

- ✓ Antimicrobial substances
- ✓ Enzymes
- ✓ Organic acids
- ✓ Probiotics

Use of biotechnological products

- Parental application of bovine somatotropin (BST) for increased conversion rate of nutrients in the animal system to bring dramatic change in the milk and meat production status. (10-20 better).
- Use of organic trace minerals Zn Methionine, Cu Lysine, Se Yeast etc., Addition of bacterial inoculants (*Lactobacilli pediococcus* sp) in silage making for improved fermentation process and for increased DMI digestibility and milk production.

Representing to the governments for augmentation of feed and fodder resources.

- ✓ To increase the quota of molasses to reduce feed cost.
- ✓ To replace the present practices of exporting oil cakes, rice bran and other animal feed ingredients.
- ✓ To impose strict quality control measures for pre mixtures and mineral mixtures.
- ✓ To take up plantation of fodder trees as an important component under the social forestry system.
- ✓ To constitute feed authority of India.

Conclusion and Recommendations

There is need to improve and increase quality forage production per unit area of available land by growing high yielding forage and fodder crops in mixed crop-livestock feeding system. Available crop residues and other NCFRs are properly utilized by harvesting crops at right time, by proper storage, processing, and conservation and judicious usage.

Effective utilization of available feed resources can be done by developing complete rations/compressed feed blocks after inclusion of feed resources. Strategic supplementation of specific deficit nutrient at catalytic levels in the rations of cattle, buffalo's, sheep and goats. Inclusion of by-pass proteins/ by-pass fats, pro-biotic or pro-biotic in the rations of high yielding cross bred animals is successful strategy. Use of newer bio-technological products by supplementation or parental application to improve meat and milk production.

These sustainable strategic measures will certainly ensure the increased availability of feed and fodder resources as well as their effective utilization for improved milk and meat production from livestock to meet the animal protein requirements of growing human population in coming years in India.

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