



Forage resource development in India

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ABSTRACT

Livestock is an important asset of small and marginal farmers in the Indian rural economy, however, its profitability is dependent on efficient feeding and marketing. Chronic shortage of feed and fodder resources during the last few decades indicates that most of the livestock were underfed. This shortage could be traced to growing livestock population, low productivity and less emphasis on forage cultivation by livestock owners. Neglect of community pastures and lack of concern for development of feed resources reflect on the performance of small ruminants. Owners did not show interest in feeding their animals due to low productivity. Sources of fodder for feeding livestock indicated that 54% of the total fodder was met from crop residues, 18% fodder from grasslands and only 28% fodder was from cultivated fodder crops. Breed improvement is the most critical factor for improving milk yield of cows and buffaloes in India and also for other species of livestock. Improved livestock will motivate livestock owners to feed better quality feeds and forages. While improving forage resources, it is necessary to address the opportunities related to production and efficient use of crop residues and increasing the fodder yield of cultivated fodder crops on agricultural lands and on wastelands and community pastures. Forage and feed development should be an integral aspect of the dairy and meat value chain to ensure proper forward and backward integration, necessary to optimize the production and profitability of livestock industry. There is a need to establish effective communication between scientists and poor farmers.

Key words: Feed development, Forage production, Profitability, Sustainable livestock husbandry, Value chain development

Livestock is a major source of livelihood security for the poor in most of the developing countries. Apart from being an important source of human nutrition, livestock is also a source of crop nutrition, power for agricultural tillage and rural transportation and a valuable asset which can be easily encashed during emergencies. Livestock has a direct influence on agricultural production. A wide range of products generated from livestock enable farmers to diversify their sources of income and absorb risk. In arid and semi-arid regions, livestock is the only source of livelihood, particularly when agriculture fails to withstand drought.

Livestock in rural economy

In India, where over 75% farmers are small and marginal holders, livestock is the main source of livelihood for a majority of the rural population. The contribution of livestock to the National GDP is about 9% and 25% to agricultural GDP. Livestock have been contributing about 15–20% to the household income of farmers, which has been steadily increasing during recent years. Among different products, milk is the major output contributing to

the GDP as well as to food security. In fact, the contribution of milk to GDP (5.86%) is more than the contribution of rice (5.77%). The demand for milk will further increase by 80% by the year 2022. Demand for meat is also likely to increase by several folds.

India has the largest number of livestock, representing over 17% of the world population. The status of livestock population and their contribution to milk production are presented in Table 1. Among 4 important species of livestock, cattle represent over 43% of the population followed by buffaloes (19%), goats (26%) and sheep (10%). While cattle and buffaloes are maintained for milk and animal power, sheep and goats are maintained mainly for meat, with milk and wool as secondary sources of income. Cattle and buffaloes, the milch animals, being large in size require substantial quantities of feed and fodder for economic management and are also partly stall fed. However, sheep and goats are mostly maintained exclusively on free grazing, although supplementary feeding can significantly benefit their growth, production and reproduction. Farmers in humid and irrigated areas prefer cows and buffaloes, while sheep and goats are popular in arid and semi-arid regions. In recent years, with greater awareness about genetic improvement and good feeding practices, cattle and buffaloes are also becoming popular

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Table 1. Growth of livestock population and milk yield in India

Year/ Type of animals	2006–07			2021–22		
	Population (m)	Production (mt)	Wet average (kg/day)	Population (m)	Production (mt)	Wet average (kg/day)
Indigenous	28.158	20.263	1.98	31.264	26.248	2.28
Crossbred	7.580	18.682	6.75	12.347	44.703	7.98
Buffalo	32.864	53.986	4.50	40.061	97.789	5.94
Goat	—	4.073	—	—	6.512	—
Total	68.602	97.004		83.672	175.252	

Source: Hegde (2006).

in semi-arid regions as a primary source of livelihood for small and poor farmers. During the last two decades, studies in drought prone, distressed districts of Maharashtra, Karnataka and Andhra Pradesh revealed that the incidences of farmers committing suicide were mostly confined to families exclusively dependent on rain fed agriculture, while the rural families dependent partly or fully on dairy husbandry for their livelihood were able to face the stress successfully. Thus livestock is an important and integral part of Indian agriculture and the rural economy.

In spite of the importance of livestock in the Indian rural economy in generating sustainable livelihood for small farmers and meeting the growing demand for milk and meat, the productivity of our livestock has remained extremely poor. The average milk yield of cattle in the world and Europe is 2,038 kg and 4,250 kg / lactation, respectively, but the average milk yield of Indian cattle is only 990 kg. Most of the indigenous cattle are non-descript due to heavy genetic erosion, resulting in low milk production. Such low yielders are uneconomical hence the owners neither bother to feed them well nor provide necessary health care, resulting in further loss of production. This is a vicious cycle and in the absence of an efficient development programme, livestock, an important asset for generation of gainful self-employment, will continue to serve as a liability.

The economic viability of livestock husbandry is dependent on genetic potential for production, good health care, balanced feeding of animals and efficient marketing of the produce. Genetic improvement and health care are the prerequisites for sustainability and efficient feeding, and marketing will help in increasing profitability. However, the profitability directly depends on the sources of feed and fodder as about 65–70% of the total cost of livestock farming is attributed to feeding. Any saving in feed and fodder cost would directly contribute to increase in profitability. Balanced feeding of milch animals is more critical as the results are reflected within a short span, almost immediately, in the form of milk production. In case of growing stock, bullocks, sheep and goats, quality of feed will reflect on the growth rate, body weight and fertility, which often remain unnoticed by the owners. Hence feeding of milch animals has greater significance for farmers, although feed management for other species is equally important.

The population growth of different species of livestock

revealed that over the last 3–4 decades goat population showed steady increase in the growth as compared to that of large animals. With poor breeding and health care services and increasing pressure on forage supply, the small farmers are shifting from large animals to small hardy species like goats, while intensifying their dependence on community resources for free grazing. Although, the economics of stall feeding of sheep and goats is negative, farmers continue to expand their herd and exploit community pastures and forest resources to feed their livestock. As the availability of fodder for these animals will have a direct influence on the growth rate and performance, continued neglect of community pastures and development of feed resources will soon reflect on the performance of these small ruminants as well, while accelerating the pressure on village common property resources. There is no shortcut to sustain livestock husbandry, without addressing the development of fodder and feed resources.

Lack of support services to improve the productivity of large animals was also an important reason for small farmers to opt for small ruminants. However, with the scientific breed improvement of non-descript low yielding cattle, the economics of dairy cattle development has become significantly better. In the semi-arid tracts of Rajasthan, where BAIF promoted cattle development programme in the early 80's, a large number of small farmers, owning non-descript cattle were motivated to avail breeding services. The initial attraction which motivated farmers to take part in cattle development was the support received from the District Rural Development Agency who diverted the ongoing schemes of the Animal Husbandry Department to support the cattle owners participating in this programme. The families living below the poverty line (BPL) were given concentrate at 50% cost to rear newly born female calves for 28 months. Community pastures were developed to enhance fodder production. Fodder mini-kits were provided to cultivate good quality fodder on their own lands. Preventive vaccinations and timely veterinary care were provided to ensure good health. Thus healthy animals were produced even by the poor, which yielded over 3,000–3,500 kg milk/ lactation. These animals were worth Rs 30,000 to 35,000 and farmers from other regions started coming to buy these premier cows. This motivated farmers in the entire

region to adopt dairy husbandry as a reliable activity for earning a sustainable livelihood. Over the last two decades, dairy husbandry has turned out to be the most reliable and primary source of livelihood for rural families living in rain fed areas. This is a clear indication that we have not made serious efforts to tap the potential of livestock in the country.

In spite of its importance in rural economy, livestock by tradition has been considered as an integral part of rural livelihood and not as an enterprise to generate income. Livestock were maintained as a source of nutritional security, both food and manure, but not to generate cash income. This is the reason why in many parts of North India, farmers were initially hesitant to make any investment in their non-descript cattle either on breeding or on feeding. When BAIF promoted cattle development programme in UP in the 80's, the farmers were not prepared to avail the services provided at their doorsteps, even free of cost. When asked about the reasons, they mentioned that "selling of cow's milk was a sin. It is as good as selling children. So what can we do with the surplus milk produced by making special efforts?" This custom was introduced long ago probably to ensure that the growing children were fed with milk. It was a custom to ensure nutritional security, but became a hurdle while promoting dairy husbandry as an economic development activity. It took a few years to understand their mindset and to convince them to change their attitude to take active part in cattle development. There was a need to create awareness and demystify the technologies before promoting cattle development as a source of sustainable livelihood. It was only then that the livestock owners could realise the need for producing better quality forage for enhancing their income.

Over the years, particularly during the last two decades, there have been significant changes in the animal husbandry sector to improve milk production. However the efforts have not been adequate to provide the required boost to enhance the productivity. There have been many players in livestock development in the country. Each of them had a specific agenda, although the overall goal was to benefit the livestock keepers. In the absence of effective coordination, there were duplication and missing gaps, which hampered the progress. Very few players were concerned about the development of feed resources although feed was the most crucial input for enhancing the production. As the value of the milk was more than the value of paddy produced in the country, it was expected that adequate investments on research and development of forage and feeds would be made. However forage research could not attract the attention of the policy makers. In the absence of good breeding and support services, even the available forage resources could not find remunerative price. Thus forage and feed development should be considered as an integral aspect of the dairy and meat value chain for ensuring success.

Forage production for improving the profitability

The economics of milk production is heavily dependent on the quantity of nutritious forage fed to milch animals.

With feeding of good quality forage, particularly leguminous fodder, feeding of concentrate can be reduced significantly. Animals yielding up to 5–8 kg milk/ day can be maintained exclusively on 48–55 kg lucerne or berseem greens, as a substitute for 4.5 to 5.0 kg concentrate. However, there are not many dairy animals, having genetic potential to produce high milk yield, by efficiently converting the fodder. With regard to inferior quality animals, in spite of feeding good quality fodder, the milk yield remains low and the farmers find it uneconomical to feed such animals. As there are no opportunities to sell surplus fodder in local markets, farmers are reluctant to cultivate fodder exclusively on fertile agricultural lands, without owning high yielding animals. Therefore it can be said that, although the promotion of forage production is a critical factor which has a direct influence on the livestock industry, forage cultivation is closely linked to the productivity of livestock and the available critical veterinary support services.

The fodder supply situation in India is extremely precarious and the gap is very wide (Table 2). The green fodder supply was adequate to meet only 42% of the demand. Even the dry fodder supply was barely adequate to meet 80% of the demand. The chronic shortage of feed and fodder resources during the last few decades indicated that most of the livestock were underfed. The shortage was severe in the Eastern region as compared to other regions.

Such shortage of feed and fodder resources could be attributed to the growing livestock population, low productivity and less emphasis on forage cultivation by the livestock owners. It is estimated that out of 500 million heads of livestock, 57 million cattle and 39 million buffaloes fall in the category of milch animals. Among cows, there are about 7.5 million crossbreds with an average milk yield of 6.5 to 7.0 kg/day. The average yield of buffaloes is around 4.0 kg/day, while the indigenous cows yield only about 1.0 kg/day. Because of low productivity, the owners are not keen to feed their low productive animals. As a result, there is no demand for fodder, although the present supply is able to meet only about 40% of the actual requirement.

The sources of fodder for feeding our livestock are given in Table 3. Prominent among the crop residues were paddy straw, wheat straw, stalks of sorghum, maize, pearl millet, groundnut, beans and grams. Although these crop residues were considered very valuable by the livestock keepers, there has been a lot of wastage in different parts of the country. In urban areas particularly around Hyderabad and

Table 2. Feed and fodder availability and requirement in India (2005–06)

Feed	Requirement (mt)	Availability (mt)	Shortfall (%)
Concentrate	123	45	63.41
Green fodder	1025	390	61.95
Dry fodder	570	443	22.28

Source: Hegde (2006).

Table 3. Sources of fodder in India

Sources	Quantity
Crop residues	54%
Cultivated fodder	28%
Grasslands	18%

Source: Hegde (2006).

Bengaluru, dairy animal owners purchased chaffed sorghum stalk even at a price of Rs 5,500 to 6,500/ tonne. Even wheat straw was sold in the range of Rs 2,000 and 3,000/ tonne, while paddy straw was sold at Rs 1,500 to 2,000/ tonne. However in many regions of Punjab, Haryana and Uttar Pradesh, farmers have been burning these crop residues, because of lack of demand in local markets. Some of these crop residues have also been diverted for industrial uses such as paper and particle boards as well as for generation of electricity. Generally, crop residues such as fodder would fetch better price than industrial raw material. Nevertheless, if farmers are selling crop residues at a lower price, it is clear that there is no demand for fodder in certain agriculture-rich areas, while certain other regions are facing fodder shortage. This reflects on the need for developing necessary infrastructure to make best use of the available fodder resources, while aiming at enhancing the production further.

The studies undertaken to analyse dairy development in India also confirm that breed improvement is the most critical factor to improve the milk yield of cows and buffaloes in India. Same is true for other species of livestock. It is only with improved livestock that the owners will have an urge to feed good quality fodder. The improved animals respond well to the feeding of better quality feeds and forages, while the benefits of feeding low productive livestock are marginal. Hence farmers owning inferior quality livestock, do not feed them properly, while letting them out for free grazing. As underfeeding has no immediate impact on the production, most of the livestock owners are not concerned about the shortage of feed resources. This aspect has to be kept in mind while developing a suitable strategy for giving a boost to livestock husbandry through better forage and feed management.

Constraints for forage production

In the earlier section, the present scenario of severe shortage of fodder on one side and neglect of available resources in the absence of better quality livestock on the other side, was highlighted. However the time has come to take a closer look at the micro level, where farmers are making investments in maintaining better quality animals to pursue dairy husbandry as an income generation activity. For these farmers, procuring good quality fodder is a major challenge. While majority of them are small holders who are unable to use their holdings for fodder cultivation, for others, cultivation is a loss of opportunity to earn higher income by growing other high value cash crops. As over 90% farmers being marginal (69.4%) and small holders

(21.75%) owning over 90–95% livestock, they are not able to devote their small holdings for cultivation of fodder crops, as their priority is to produce foodgrains. Non-availability of critical inputs such as good quality seeds required for cultivating traditional fodder crops, is another problem. Thus the area under fodder cultivation has remained stagnant for a long period. Presently it is estimated that only 4.4% of the total cropped area is devoted to fodder production. This area has remained almost static since 2–3 decades and there is very little scope for increasing the area under fodder production due to the pressure on land holding to divert the area for other uses.

In a forage production study undertaken in the dairy belt of Western Maharashtra, it was observed that in rainfed areas, the farmers practised controlled grazing on community lands or in the forest areas around their village during the *kharif*. After the harvest of the *kharif* crop, these animals were let out for free grazing on agricultural fields. However high yielding crossbred cows and buffaloes were stall-fed by most of the farmers. In irrigated areas, there were severe restrictions on free grazing and farmers were compelled to stall-fed or get rid of their unproductive animals. Among these livestock owners, only about 2% were cultivating fodder crops. Those who had cultivated fodder had good quality crossbred cows and buffaloes and were engaged in selling surplus milk. Dairy farming was an income generation activity for them and feeding green fodder could enhance milk yield and reduce the cost of milk production, by reducing the quantity of concentrate fed to these animals. The other category of farmers, who cultivated fodder had good quality bullocks, which needed either concentrate or green fodder during their peak working seasons. Farmers of both these categories, grew fodder to reduce the purchase of concentrate feed without affecting the productivity of their livestock (Hegde, 1991). In the absence of superior quality livestock, farmers are reluctant to grow fodder crops as they can divert their precious land resources for cultivating many other cash crops which can provide much higher returns. Thus it is essential to promote fodder development as part of the dairy or meat value chain to ensure proper forward and backward integration required to optimise the production and profitability of livestock industry.

The major fodder crops cultivated in India are sorghum, maize, *bajra*, oats, hybrid Napier, guinea grass, paragrass, lucerne, berseem, cowpea, velvet bean and others. Among these crops, sorghum, maize, oats, lucerne and berseem are more popular because of easy availability of seeds of improved varieties and well developed technology to increase the forage yield and quality. However these crops require good quality land, assured source of water, higher doses of fertilizers and regular care, apart from good quality seeds from reliable sources. Cultivation of forage and regular harvesting almost on a daily basis, demands a large number of workforce which is very expensive. In the absence of efficient preservation and storage techniques, chances of huge wastage of fodder are likely. Hence farmers

are reluctant to make heavy investments on fodder production.

While fertile lands with assured irrigation are diverted for growing high value crops, large stretches of marginal and wastelands are lying underutilised across the country. There are also opportunities to introduce fodder as an intercrop or as a soil binder under the watershed development programme. Most of the fodder varieties presently released for cultivation, are not the most ideal for cultivation on such low productive lands. Identification of suitable fodder species for such areas and developing suitable cultivation practices are necessary to boost fodder production on marginal and wastelands in the future.

Strategy for increasing forage production

While improving the forage resources, it is necessary to address the opportunities related to production and efficient use of crop residues, and increase the fodder yield of cultivated fodder crops on agricultural lands as well as on wastelands and community pastures. The strategy should cover selection and breeding of high yielding and stress tolerant fodder crops and varieties, improving the yields through sustainable production practices, efficient conservation and strengthening the value chain of dairy and meat producers to provide various critical services required to optimise the income.

Efficient use of crop residues: Although about 54% of the fodder needs are met from various crop residues, no serious efforts are being made to either increase the yield or quality of this fodder. During the era of Green Revolution, deliberate attempts were made by plant breeders and agronomists to release high yielding varieties by reducing the plant height, leafy biomass and stalk yield. Such a plant breeding policy seriously suppressed the fodder yield. However these varieties were very well accepted as the foodgrains fetched higher price, while the crop residues had no significant value, due to low productivity of livestock. Unable to appreciate the value, farmers in many regions have been wasting the crop residues, either by feeding the stalk without processing or by burning. Subsequently, with the development of dairy husbandry particularly in peri-urban areas, crop residues are now in good demand. During the last 5 years, the retail price of sorghum stalk was almost 50% of the value of sorghum grain. With such demand, farmers have started shifting back to the old varieties with higher stalk yield. Similar demand for high stalk yielding varieties has now set a new direction for breeding and selection of new varieties, which have higher fodder quality and yield, without any reduction in grain yield. This calls for setting a new mandate for plant breeders as well as agronomists to popularise forage-rich food crops in the future. Selection of new genotypes and varieties of food crops having high forage value without reduction in foodgrain yield, is a continuous process which can be a joint mandate for Forage Research Institutions at the National level in collaboration with plant breeders and agronomists engaged in breeding of food crops. Further

efforts are needed for popularisation of the selected varieties to replace the old varieties.

Timely harvesting of crop residues, proper processing and storage can also enhance the quality of the forage and prevent wastage. Harvesting of stalk before it turns fibrous for direct feeding or converting into silage, can keep the nutritive value high while reducing methane generation by the ruminants. There are various methods of treating the crop residues before feeding, to improve its nutritional value. It has been reported that even chaffing of stalk before feeding, can reduce the emission of methane by 10% while saving the wastage by 25–30%. Further treatment of crop residues by way of soaking in water and treating with steam under pressure, can also improve the nutritive value and palatability. There are other methods like urea treatment in addition to molasses and physico-chemical methods like urea ammonisation, by storing the urea treated straw in anaerobic condition which can further improve the quality.

Wastage of crop residues by way of burning and diverting its uses for industrial purposes or power generation should also be prevented on priority. The important reason for such wastage can be attributed to forage surplus conditions in certain pockets, particularly in areas where green revolution was launched successfully. Farmers in these areas take 2–3 crops in a year and they have very little time available between two crops. Furthermore, the cost of labour being high, these farmers have no interest in diverting their energy to process and store the crop residues till they complete the sowing of the next crop. Lack of space, hazards of fire and damage caused by rains are other factors influencing the farmers to dispose off the crop residues as early as possible. The easier option for them is to either burn or sell it off to local buyer irrespective of any price realisation. To avoid such practices, it is necessary to set up fodder banks in fodder surplus areas and process into compact feed blocks either directly or in addition to concentrates and minerals. Such blocks can be easily transported to different parts of the country which are facing fodder shortage. Shortage of fodder is often a temporary problem which is not confined to any particular region. The shortage arises either due to crop failures or due to natural calamities like floods and droughts which are unpredictable and not location-specific. Hence fodder banks established in fodder surplus areas need to keep a watch and look out for opportunities to supply to regions facing seasonal shortage.

Establishment of a complete feed production unit can also enhance the demand for fodder, as assured supply of complete feed at an affordable price can motivate a large number of small farmers to expand their livestock development activities as a reliable source of livelihood. To operationalise such decentralised feed production units on an economically viable scale, the units can be operated by local livestock keeper groups who have a major stake in procurement, distribution and its viability.

Fodder crops for wastelands: Considering the limitations of traditionally cultivated fodder crops, it is necessary to introduce various non-traditional fodder crops for growing

on marginally productive farms and denuded community lands. There are many hardy grasses and legumes like stylo, seratro, hedge lucerne, etc., which can be grown on wastelands without irrigation. There are many fast growing shrubs and trees which can be lopped regularly as fodder. Such tree species can be established on field bunds, home gardens and along farm boundaries.

There are large stretches of degraded wastelands which are not only lying idle and are underutilised but are also accelerating soil erosion, surface run off of rain water and hosting a wide range of pests and diseases. It is estimated that over 100 million ha in the country are presently underutilised. These lands include over 25–30 million ha of degraded forest lands, 45–50 million ha of agricultural lands unsuitable of crop production, 9–10 million ha sodic wastelands while the rest are ravines, pasture lands and revenue wastelands. Development of these lands for forage production will not only ensure enhanced supply of superior quality forage but will also help in conserving the natural resources and recharging groundwater, while improving the bio-diversity.

Watershed development programmes in the country can also provide an excellent opportunity for promoting fodder production. In the watershed development programmes implemented by BAIF in Saurashtra region of Gujarat and several districts in Karnataka, the immediate impact was the regeneration of various native grass species on field bunds and borders. Neither the implementing field staff nor the farmers anticipated any such increase in the grass production. However after realising this potential, seeds of hardy legumes were sown on field bunds, along water channels and on barren lands to enhance forage production while promoting soil and water conservation.

While developing wastelands through agroforestry, there is scope for promoting forage legumes and grasses. In the agri-horti-forestry projects promoted by BAIF in South Gujarat, Rajasthan and Karnataka, the fertility of the lands was extremely poor. Such lands were developed for cultivating hardy, drought tolerant horticultural species such as mango, cashew, custard apple, tamarind, Indian gooseberry, etc. The bunds and borders of these plots were used for growing fodder and fuel tree species like subabul, gliricidia, acacia, sesbania, etc. Most of the farmers found these species to be reliable sources of fodder, particularly during summer and monsoon, when other sources of green fodder were absent. The interspace between fruit plants was used for either food crop production or forage production, depending on soil productivity and moisture supply. Where the soil productivity was low, farmers preferred to grow fodder instead of agricultural crops and maintained a few cows or buffaloes to boost their income.

Development of community pastures is another excellent opportunity. Generally, about 5% to 10% of the land area in every village is reserved for community pastures. However, a part of this land is encroached or diverted by the local government for other purposes. Nevertheless, a significant portion is still available for common grazing.

Over the years, in the absence of controlled grazing and care, the productivity of these community pastures has been severely eroded. Such lands can be brought under silvipasture development involving local people. In a project initiated by BAIF in Asind taluk of Bhilwara district in Rajasthan, the villagers came together to develop a part of the community land under silvipasture development. The major activities included the establishment of live hedges, gully plugging, contour bunding, sowing of forage seeds such as *Cenchrus setigirus* (Dhaman grass) and *Stylosanthes hemata* (Stylo) before the onset of monsoon. Saplings of *Acacia* and *Prosopis cineraria* (Khejdi) were also planted and stray grazing was prohibited. Although the rainfall was only 650 mm, the grass growth was fairly good, right in the first year. Apart from cutting the grass, there was also an opportunity for farmers to let their animals for grazing for a period of 15–20 days after cutting the grass. During subsequent years, the grass cover increased and yielded about 3.5–4.0 tonnes of dry fodder per ha. In addition to increased grass production, there was a positive improvement in the micro-climate and bio-diversity.

There is a need to develop suitable fodder shrubs, trees and grasses for development of pasture lands. Fodder species for introduction under agroforestry need to be shade tolerant and resistant to pests and diseases. Establishment of leguminous shrubs particularly in fruit orchards, can even enhance the fruit production. Now is the time to set priority to breed improved varieties of various non-traditional fodder crops suitable for watersheds and wastelands. While breeding these varieties, major consideration should be given to tolerance to drought and harsh soil conditions instead of judging on the basis of their yield performance. Seed production of elite genotypes should also be taken up on a large scale to meet the demand.

Increasing forage yields: Dairy farmers who have undertaken forage production are not able to optimise the yields and maximise the returns due to several reasons. These include poor quality soils, inadequate fertilizer application, moisture scarcity, improper timing of sowing and inadequate facilities to transport and store the forage, till it is fed to livestock. Selection of suitable forage crops to suit the local agro-climatic conditions, non-availability of good quality certified seeds, lack of knowledge about cultivation practices and lack of marketing opportunities to sell the surplus forage at remunerative prices are also important problems, contributing to the poor response to forage production. Except for a few crops like sorghum, maize, lucerne and berseem, which are cultivated in a few isolated pockets in different regions, most of the farmers are not aware of other forage crops, which have special advantages under adverse agro-climatic conditions.

Resource-poor farmers often cultivate forage on low productive soils to make use of the idle land and do not apply the required quantity of nutrients. Such farmers have several options to boost crop yields by applying low cost inputs such as soil amendments, organic manure and biofertilisers. Unfortunately, most of them do not bother to

apply biofertilisers and soil amendments due to ignorance and difficulty in procuring them. This problem can be attributed to lack of an organised set up for extension, distribution of forage seeds and other inputs in the country. Serious thought should be given for developing a forage seed distribution network, at least in selected pockets where dairy husbandry has developed as an economic activity. There has also been a wide communication gap between the forage development programme and the livestock extension department. As a result, there is no free flow of information from either side. A well established communication network would help the forage scientists to understand the problems of the dairy farmers and offer suitable interventions.

Improving profitability: Farmers generally compare the economics of forage with other agricultural crops. Forage cultivation on agricultural lands is least attractive, unless they own superior quality livestock. Hence the return is mainly influenced by the quality of livestock. Thus efforts should be made to promote fodder production in the areas where livestock husbandry is progressing well and the productivity of animals is high. There is also a need to develop a fodder market in the long run, where farmers can sell the surplus forage. A fair market can motivate the farmers to study the price movement and cultivate fodder if the prices realised are remunerative.

Forage production, particularly harvesting, requires larger labour force which is not available during certain critical seasons and is also becoming expensive. It is particularly true for organised farms where unionised labour is inefficient and undependable. Hence it is necessary to develop suitable machinery for harvesting fodder, which can be operated by multipurpose power tillers and tractors which can become popular among dairy farmers.

Opportunities for preserving surplus forage into forage pallets, silage and hay, should also be explored by developing suitable technologies. Presently, such processing is not very popular due to high cost.

Special focus on feeding of small ruminants

Most of the sheep and goat keepers are generally small holders or landless, who cannot afford to keep cattle and buffaloes. While keeping small ruminants, the farmers do not plan for mobilising the required feed resources. Instead, these animals are let out for free grazing or taken out to community pastures and village woodlots by one of the members of the family. In most cases, the sheep and goat keepers do not provide supplementary feed to their livestock after they return from grazing. In areas where tree population on common lands is dense, goat keepers bring lopped branches for supplementary feeding.

To overcome the problem of fodder scarcity likely to be faced by pregnant goats, many goat keepers prefer to breed their goats during April-May to facilitate kidding in September-October when adequate fodder is available for the lactating goats. However such plans make no significant effect on the growth and productivity. Furthermore, during

summer, when availability of forage is at the lowest level on community lands, the rate of conception is also observed to be lower due to nutritional deficiency. Small ruminant owners particularly the goat keepers generally sell these animals as and when they need cash, except in case of a few special occasions such as Bakri Id and Durga Puja festivals, when the male goats are in demand for sacrifice. While goat keepers do take special efforts to feed their animals before these festival seasons, no efforts are made to fatten the goats intended for selling during other times. Some efforts to provide supplementary feeding to small ruminants during critical stages such as prior to breeding, during pregnancy, lactation and before selling would certainly help the goat keepers to realise better price. This can be done through awareness about nutrition and balanced feeding, promotion of forage cultivation, particularly woody perennials around their houses, farm bunds and wastelands, collection of foliage and pods of different tree species from community lands, etc. pods of acacia, prosopis, sesbania, bahunia, samania and albizia are very nutritious and palatable. However it is better to collect and crush them before feeding. It is also possible to mix the crushed pods with locally available biomass to process into complete feed. There are different types of industrial by-products, particularly from the food and beverage industries located in urban and peri-urban areas. Groups of goat keepers can tie up with these industries to collect the by-products for processing and feeding their animals. Such efforts to produce complete feed at the village level, preferably by the livestock owners, would greatly help in enhancing their profitability.

Need for forage-based development research

No doubt, significant research has been carried out by the IGFR, NDRI, Agricultural Universities, Forestry Research Institutions and Non-Government Organisations to identify suitable forage crops, domesticate them, breed new varieties, develop cultivation practices and develop facilities for large scale seed production. However, there has been no significant change in the status of forage supply in the country mainly because these research findings are applicable to only a few regions particularly for humid arid and sub humid conditions.

Indeed, it is a matter of serious concern that forage production has not been picked up on a massive scale, in spite of significant progress in dairy development. This calls for an in-depth study, particularly in newly emerging milk sheds, to understand the mechanism to meet the nutritional needs of milch animals. There is good scope to analyse current feeding practices and help them to introduce balanced feeding, using the available fodder resources.

As the supply of forage and feeds determine the profitability of livestock husbandry and livestock being the major source of livelihood for the rural poor, we need to set our priority to address the needs of small farmers by developing various forage production systems, suitable for arid lands. Unfortunately these target groups who own a

major portion of the livestock are neither literate nor resourceful to demand new technologies. Keeping this in mind, we need to interact with them to assess their needs and develop suitable technologies and systems which can benefit them.

So far, the research institutions have been involved in research and development without having direct linkage to the target communities. As a result, the scientists are not able to understand the problems of the farmers and the farmers are not able to learn about technologies available to them. It is necessary to take a fresh look at the policy to establish a vibrant communication between scientists and the target communities through the following initiatives:

1. Establishment of field research units to promote on-farm studies and test the technologies under field conditions;
2. Carrying out joint research studies in association with

farmers' organisations, voluntary agencies, State Agriculture and Animal Husbandry Developments and Krishi Vigyan Kendras;

3. Establishment of an Extension Division to collaborate with various farmers' organisations, VOs and Agricultural Training centres and participation in Kisan Melas and seminars to disseminate the technologies, while receiving their feedback regularly;
4. Encourage forage scientists to participate in the value chain of dairy husbandry and meat production to promote forage production for increasing the profitability.

REFERENCE

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