



P-ISSN: 2349-8528
E-ISSN: 2321-4902
IJCS 2019; SP6: 216-222

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(Special Issue -6)
3rd National Conference
On

**PROMOTING & REINVIGORATING AGRI-HORTI,
TECHNOLOGICAL INNOVATIONS**
[PRAGATI-2019]
(14-15 December, 2019)

Strategies to increase quality and availability of green fodder production in eastern region of India: A review

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Abstract

India is blessed with diversified type of livestock and it is one of the largest in the world. However, the area under fodder cultivation decreasing day by day as increasing cultivation of cereal and cash crops. Therefore, there is a tremendous pressure of livestock on available fodder as land has been decreasing for green fodder production. The green fodder production in the country is not sufficient to meet the requirements of the growing livestock population and also the forages offered to animal are mostly of poor quality. At present, the country faces a net deficit of 10.95% dry crop residues, 35.6 % green fodder and 44% concentrate feed ingredients (*Vision document-2050, ICAR-IGFRI, Jhansi*). The animals are largely fed on low quality fodders such as different crop residues, paddy and wheat straw, weeds and wild grasses from wastelands and forest. Such low quality feeding material leads to low milk productivity per animal. Under this situation needs to be addressed through alternative sources of green fodder which could provide good quality green fodder round the year so that the milk productivity as well as animal health may not jeopardised. Cereal-legume intercropping has been recognized as a beneficial crop production system for higher fodder production per unit area per unit time.

Keywords: Livestock population, green fodder availability and profitability

Introduction

Green fodders play important role in the profitability of the livestock production. The objective of the increased milk production can be met only through ensuring availability of good quality fodder in balanced ratio. Success of dairy farming is largely depends on the feed and fodder of high nutritional value, which accounts for 65-70 per cent expenses incurred over the animal feeds (Kumar *et al.*, 2012) [7]. The demand of green and dry fodder will reach to 1012 and 631 million tonnes of by the year 2050 respectively. At the current level of growth in forage resources, there will be 18.4 % deficit in green fodder and 13.2% deficit in dry fodder in the year 2050. In the country, there is major problem of low quality crop residues for forage requirement of livestock which is not enough for maintenance of animal health and productivity. The two obvious approaches to bridge this gap between fodder requirement and availability are either to increase in area under fodder production or to increase the productivity per unit area per unit time under the present scenario of farming of existing production system. Although, shortage of animal feed and fodder is a major issue that needs to be addressed but simultaneously quality of feed and forage cannot to be ignored. Green forage availability is very important to maintain livestock health and productivity and this is particularly essential in dairy entrepreneurship where consistent and regular supply of green

Fodder is imperative to sustain the milk production. Green herbage in addition to energy also provides vitamins, minerals with better dry matter digestibility. All the forage crops such as maize, sorghum, cowpea, pearl millet, oat, barley, and berseem crops are palatable and nutritious but due to seasonal nature there is scarcity of fodder during the remaining period of year.



Fig 1

Current scenario of livestock population and fodder cultivation in India

The total livestock population consisting of Cattle, Buffalo, Sheep, Goat, pig, Horses & Ponies, Mules, Donkeys, Camels, Mithun and Yak in the country is 512.05 million numbers in 2012. The total livestock population has decreased by about 3.33% over the previous census. (19th Livestock Census-2012, All India report). The Bihar state owns 19798.75 thousands cattle and buffalo livestock in which 12231.52 thousands are cattle's and 7567.23 thousand buffaloes (DAHDF- 2014). Only large farmers (< 5 %) grow any fodder, small and a marginal farmer (90 %) depends on crop residues for feeding the livestock. Further increase in the acreage of the fodder crops is not possible due to increased competition between various land uses for cultivable land. The acreage under green forage in state is almost negligible (0.21 % of the total cultivable area). Straw availability (kg/ adult livestock) is only 3.5 kg against the average requirement of 10-12 kg. (Anonymous, 2016) [2]. This gap in demand and supply may further rise due to consistent growth of livestock population at the rate of 1.23 % in the coming years. Composition of livestock is also changing with shift towards small ruminants due to high growth in meat sector. Buffaloes and goats are attaining major importance. A vast array of forage species are grown under varying management situations in different agro-ecological regions of the country. Agriculture and animal husbandry in India are interwoven in the intricate fabric of the society in cultural, religious and economical ways, as mixed farming and livestock rearing forms an integral part of rural living. The agriculture and livestock sector still provides employment to 52 % of the work force. Animal husbandry promotes gender equity. More than three-fourth of the labour demand in livestock production is met by women. The share of women employment in livestock sector is around 90 % in Punjab and Haryana where dairying is a prominent activity and animals are stall fed. Their involvement in fodder production and utilization is very important.

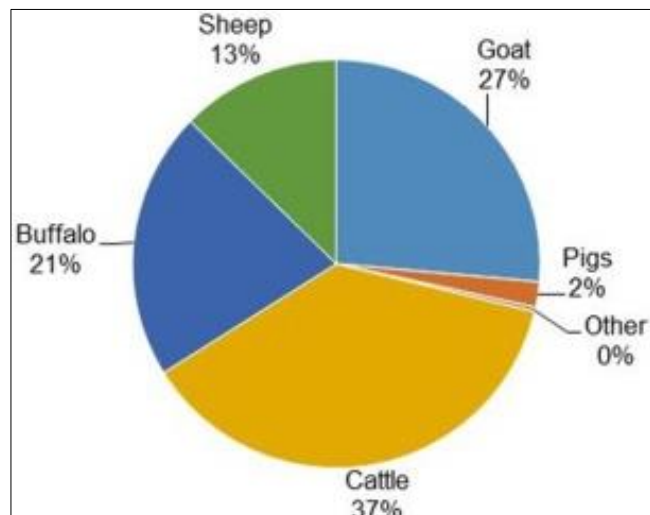


Fig 2

The number of animals in milk in cows and buffaloes has increased from 77.04 million to 80.52 million showing a growth of 4.51%. Camel population has decreased by 22.48% over the previous census and the total Camels in the country is 0.4 million numbers in 2012. The total Donkey population in the country have decreased by 27.22% over the previous census and the total donkeys in the country are 0.32 million numbers in 2012 (table-1).

Table 1: Total Livestock Population in India, Census-2012 (Million Numbers).

Species	2002	2007	2012
Cattle	185.2	199.1	190.9
Adult Female Cattle	64.5	73.0	76.7
Buffalo	97.9	105.3	108.7
Adult Female Buffalo	51.0	54.5	56.6
Total Bovines	283.1	304.4	299.6
Sheep	61.5	71.6	65.1
Goat	124.4	140.5	135.2
Horses and Ponies	0.8	0.6	0.6
Camels	0.6	0.5	0.4
Pigs	13.5	11.1	10.3
Mules	0.2	0.1	0.2
Donkeys	0.7	0.4	0.3
Yak	0.1	0.1	0.1
Mithun	0.3	0.3	0.3
Total Livestock	485.0	529.7	512.1

Source: Livestock Census, 2012, DAHD & F, GOI

Demand and supply of forage and feed

The estimates of fodder production in the country vary widely. Fodder production and its utilization depend on the cropping pattern, climate, social-economic conditions and type of livestock. The cattle and buffaloes are normally fed on fodder available from cultivated areas, supplemented to a small extent by harvested crop, grasses and top feeds. The three major sources of fodder supply are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands. The present availability of green fodder from cultivated areas is 590.4 million tonnes, which includes supplementation from sugarcane tops and seasonal weeds. Similarly, in case of dry fodder, total availability is 467.6 million tonnes, which constitutes straw of cereal crops like rice, wheat, barley, maize, sorghum, pearl millet and other crops like groundnut and chickpea and dry grass from grazing lands and forests

(Table-2). The available forages are poor in quality, being deficient in available energy, protein and minerals. To compensate for the low productivity of the livestock, farmers maintain a large herd of animals, which adds to the pressure on land and fodder resources. Due to ever-increasing human population pressure, arable land is mainly used for food and cash crops. Thus there is little chance of having good-quality arable land available for fodder production, unless milk production becomes more remunerative to the farmers as compared to other crops.

Table 2: The scenario of feed and fodder availability (MT) in India, till -2050

Year	Supply		Demand		Deficit as % of actual demand	
	Green	Dry	Green	Dry	Green	Dry
2010	525.5	453.2	816.8	508.9	35.66	10.95
2020	590.4	467.6	851.3	530.5	30.65	11.85
2030	687.4	500.0	911.6	568.1	24.59	11.98
2040	761.7	524.4	954.8	594.9	20.22	11.86
2050	826.0	547.7	1012.7	631.0	18.43	13.20

Source: India's livestock feed demand: Estimates and projections. Dixhit, A. K. and P.S. BIRTHAL. 2010. Agricultural Economics Research Review, 23(1):15-28.

Fodder development programmes in India

To accelerate the production of fodder through intensive promotion of technologies to ensure its availability throughout the year, Rs.300 crore had been provided during 2011-12 for Accelerated Fodder Development Programme to benefit farmers in 25,000 villages. Allocation for Accelerated Fodder Development Programme during 2012-13 & 2013-14 was Rs. 100 crore each. The scheme has been implemented as Additional Fodder Development Programme with an allocation of Rs.39.63 crore during 2014-15 and Rs.50 crore during 2015-16. Department of Animal Husbandry is having 8 Regional Fodder Stations located in different agro-climatic zones of the country are producing foundation seeds. These foundation seeds would be made available to the State Governments to multiply and produce certified seeds to be made available to animal and dairy farmers for fodder production for which funds are available under NLM. The States also have sufficient funds and autonomy to undertake development of feed and fodder besides other agricultural and allied activities under the Rashtriya Krishi Vikas Yojana (RKVY). Further, as per the latest guidelines, MNREGA Scheme funds can also be utilized for improving availability of fodder.

Table 3: State wise area under pasture and other grazing land in the country - (000 ha)

Name of state	2010-11	2011-12	2012-13
Andhra Pradesh	554	553	515
Arunachal Pradesh	18	18	18
Assam	160	160	160
Bihar	16	16	16
Chhattisgarh	855	863	861
Goa	01	01	01
Gujarat	851	851	851
Haryana	27	28	25
Himachal Pradesh	1508	1508	1508
J & K	119	123	114
Jharkhand	110	121	114
Karnataka	912	908	908
Kerala	00	00	00
Madhya Pradesh	1328	1321	1286
Maharashtra	1242	1244	1245
Manipur	01	01	01
Meghalaya	00	00	00
Mizoram	05	05	05
Nagaland	00	00	00
Odisha	513	508	536
Punjab	04	04	05
Rajasthan	1694	1694	1694
Sikkim	00	00	00
Tamil Nadu	110	110	110
Tripura	02	02	02
Uttarakhand	199	199	192
Uttar Pradesh	66	66	66
West Bengal	05	04	03
Andaman & Nicobar	04	04	04
Dadar & Nagar Haveli	01	01	01
Delhi	00	00	00
Puducherry	00	00	00
Total	10305	10311	10240

Source: Department of Animal Husbandry, Dairying & Fisheries Ministry of Agriculture and Farmers Welfare, Government of India, 2016

Constraints in enhancing green fodder production

1. Increased Human population forced us to grow more grain crops rather than fodder crops.

2. Green revolution included mainly grain crops and fodder side tracked.
3. Productivity is low due to non-availability/ non adoption of production technology.

4. Livestock farmers are small (21.75%) and marginal (69.4%) are not paying much attention on feeding of poor yielder animals.
5. Regional imbalances of fodder availability.
6. High transport cost and burning of crop residue.
7. Non availability of trained and expert human resource in fodder production.
8. Non availability of quality seed.
9. Lack of knowledge among farmers (Poor TOT) about fodder production technologies

Strategies to enhance following strategies can be adopted

1. Seed Production and availability

- Seed availability of forage crops is just 15-20% of national requirement.
- Fodder seed production must be encouraged at ICAR institutes and SAU's.
- Livestock/ dairy co-operatives must be involved in seed chain i.e. Production and distribution.
- Emphasis on creation of seed processing and storage facilities.
- Suitable regions for increased seed productivity for different fodder crops be identified.
- Compulsory targets of fodder seed production must be linked with general seed production (At least 3-5%).
- Development of seed standard and seed production technology for fodder crops and grasses.

2. Production technology (Kumar, 2016) [7]

- Need to highlight economic viability of round the year green fodder production in comparison to conventional agriculture to bridge the gap in demand and availability.
- Regular interface between ICAR and DAH and also among ICAR institute related to fodder and animal sciences.
- Veterinary Officers must be given training regarding fodder production technology.
- Fodder crops have opportunity to fit well in contingent crop planning as short duration, catch/intercrop or alley crop.
- Till now more than 200 varieties of fodder crops has been developed, further suitable varieties for lean periods, good quality fodder (HQPM Fodder) be developed.

3. Conservation of fodder

- Development of cost effective equipment for processing of feed and fodder.
- Use Chaff-cutter to minimise wastage of fodder.
- Establishment of fodder banks.
- Conversion of fodder into feed blocks.
- Conservation in form of hay and silage.
- Enrichment of straw/stover with urea.

4. Transfer of technology

- Awareness creation about fodder production technology
- On-farm evaluation of fodder technologies
- Capacity building of farmers through desired specific action plan for transfer of technology of fodder crops.
- Regular interface between ICAR and DAH and also among ICAR institute related to fodder and animal sciences.
- Hay and silage demonstrations.

5. Research

- Development of fodder production technologies for different cultivated fodder areas and there adoption adaptive trials.
- Exploration of possibilities of hydroponic fodder in CDF through intensive research to standardization of technology for various crops/grains.
- Research activities must be expanded on quality /anti-quality aspects.
- Development of new cultivars of fodder crops and grasses.
- Nutritional evaluation of forage resources and development of feeding strategies.

6. Area expansion & policy

Area expansion is not possible but fodder crops can be grown in various cropping systems viz.

- Intensive forage production system (Round the year)
- Food-fodder production system (fodder-wheat/ rice-fodder)
- Non-food, fodder production system (Intercropping of fodder in cotton, potato and sugarcane)
- Fodder production during lean periods (Turnip, chinese in winter and maize, cowpea in summer)
- Allay of horticultural crops e.g. growing hamil variety of Ginni grass.
- Management of grazing land, non-cropped areas, problematic areas, pasture lands and rainfed areas etc.
- Provisions of subsidies
- On Seed and Chaff cutters.
- Effective enforcement of law related to burning of crop residue.
- By adopting above strategies India can produce sufficient fodder for its animal wealth.

Need for an inclusive fodder development programme

In the current scenario, where competing demands on land renders even expansion of food/cash crops a difficult proposition, the probability of increasing area under fodder crops is nearly impossible. It is therefore imminent to adopt a multi-pronged strategy for adequate availability of fodder in order to provide a buffer to the farmer even in times of climatic variability. This strategy interalia envisages supply of quality seeds, promoting production of fodder crops, extending fodder cultivation to currently fallow and unutilized lands, promotion of dual purpose varieties of crops which has the potential of meeting fodder requirements in season and off-season, promotion of non-traditional fodder, post-harvest technologies for preservation of fodder etc. Besides, improving productivity in areas already under fodder cultivation, improving productivity of grazing and pasture lands, raising perennial fodder crops on field bunds and boundaries, peri-urban areas and exploiting unutilized and underutilized fodder crops are also some of the promising options to enhance fodder availability. Plant Breeders in India have also identified a number of varieties/hybrids which could give a better quality and higher yield of crop residue without any compromise in grain yield. This would provide an opportunity for augmenting the availability of fodder from crops like pearl millet, sorghum, maize and oat (Department of Agriculture & Cooperation, Ministry of Agriculture, 2011)

Optimum utilization of land resources

The number of livestock is growing rapidly, but the grazing lands are gradually diminishing due to pressure on land for agricultural and non-agricultural uses. Most of the grazing lands have either been degraded or encroached upon restricting its availability for grazing in table- 3. Under Jhansi (U.P.) conditions, planting of maize with cowpea in 2:2 intercropping system appeared most productive and

remunerative system with land equivalent ratio of more than one in all intercropping treatments indicating a better land utilization under multiple cropping than under sole cropping (Kumar *et al.*, 2005)^[7]. Use of quality fodder seeds including dual purpose grains like bajra, maize and Jowar, etc., is essential for improving productivity. Some of the cultivated fodder species for different regions are indicated below –

Table 4: Fodder species in different land situations for improving quality fodder production

Type of land	Rainfed Area	Irrigated Area
Arid Tracts	Jowar, Bajra, Moth, Guar, Lobia	Lucerne, Berseem, Oats, Maize, Jowar, Bajra and Barley
Semi-dry	Bajra, Jowar, Lobia, Moth, Guar, Velvet Bean, Field Bean, Guinea grass,	Jowar, Maize, Lobia, Teosinte, Lucerne, Berseem, Sarson, Turnips, Hybrid Napier, Oats, Sudan grass and Guinea grass
Semi-wet	Dinanath Grass, Jowar, Lobia, Rice Bean, Velvet Bean, Teosinte, Sunnhemp	Berseem, Oats, Sudan grass, Hybrid Napier, Guar, Jowar, Maize, Para grass, Rhodes and Setaria
Wet regions	Jowar, Dinanath, Rice Bean, Coix	Berseem, Oats, Hybrid Napier, Guinea, Lucerne, Berseem, Sarson, Turnips, Hybrid Napier, Oats, Setaria and Para grass.

Inadequate availability of quality fodder seeds is a major constraint. Fodder seed production is not remunerative in many of the fodder crops. State Governments may take initiatives to encourage farmers for taking up the production of high yielding varieties by providing sufficient incentives to farmers for production of fodder seeds of high yielding

varieties by way of assured procurement with a remunerative price and assistance of inputs. Following high yielding fodder varieties may be considered for seed production programme for improving fodder yield per hectare in respect of existing area under fodder:

S. No.	Name of the fodder crop	Name of varieties
1	Maize	African tall, J-1006, Vijay composite.
2	Sorghum	SSG 59-3, PC-23, PC-9, PC-6, HC-136, MP Chari, CO-FS-29,
3	Hybrid Napier	IGFRI-6, IGFRI-10, CO-4, NB-21, PNB-84
4	Bajra	Giant bajra, L-74, GFB-1, Raj. Bajra chari-2, HC 20, AVKB-19

Intensive forage production systems in Irrigated lands



Only way to meet the fodder needs of livestock is to look for increased productivity per unit land area and also through integration of fodder crops in the cropping system. This needed breakthrough in increasing productivity and sustaining availability of green forages is possible through tailor- made technological intervention in specific niches. Considering the needs of dairy farmers and small livestock keepers for round

the year supply of green fodder producing maximum forage from a small piece of land, overlapping cropping system was developed at IGFRI, Jhansi. This system consisted of raising berseem, inter-planted with hybrid Napier in spring and intercropping the inter row spaces of the grass with cowpea during summer after the final harvest of berseem. In this production system, 3-4 fodder crops are cultivated on same piece of land in a calendar year for continuous supply of fodder to dairy animals throughout the year. It is temporal and spatial intensification of cropping system. It is useful for those areas where dairy has come up at commercial scale especially in peri-urban and milk shed areas.

Intensive forage production systems aims at efficient utilization of land and other inputs for maximum fodder production per unit area per unit time. These crop sequences are tailored with an objective of achieving high yield of green nutritious forage and maintaining the fertility of the soil. Under assured irrigation conditions of central India, multiple crop sequences like sorghum + cowpea - berseem + mustard - maize + cowpea and sorghum (multicut) + cowpea - berseem + mustard are promising. Most promising cropping systems recommended for different agro-climatic and soil conditions and their forage yields potential are given in table 5.

Table 5: Intensive forage crop rotations for different agro-climatic zones of India

Crop rotation / climate & soil	Green fodder yield (t/ha/year)
Hill and Northern Region	
Sub-temperate, Moist, Red soil	
1. Maize + Cowpea - Lucerne + Oats - Mustard	85
2. NB Hybrid + Velvet bean - Berseem + Mustard	123
Tarai, Red & yellow soil	
1. Maize + Cowpea - Toria - Oats	177
2. NB Hybrid + Berseem - Cowpea	121
Semi-arid, Sandy loam soil	

1. NB hybrid + Berseem	212
2. NB hybrid + Lucerne	176
Central and Western Region	
Semi-arid, Red soil	
1. NB hybrid + Cowpea - Berseem + Mustard	255
2. Sorghum + Cowpea - Berseem + Mustard - Maize + Cowpea	176
Sub-humid, Black soil	
1. NB hybrid + Cowpea - Berseem	176
2. Sorghum + Cowpea - Berseem + Mustard - Sorghum + Cowpea	169
Semi-arid, Black soil	
1. NB hybrid + Cowpea - Lucerne	253
Eastern Region	
Sub-humid, Red acidic soil	
1. Pearl millet + Cowpea - Maize + Cowpea - Oats	103
2. Maize + Cowpea - Sorghum + Cowpea - Berseem + Mustard	96
Sub-humid, Alluvial soil	
1. Maize + Cowpea - Dinanath grass - Oats	131
2. Maize + Rice bean - Berseem + Mustard	112
Humid, Acidic soil	
1. NB hybrid (perennial)	106
2. Maize + Cowpea - Maize + Cowpea - Maize + Cowpea	85
Southern Region (Sub-humid, Black soil)	
1. NB hybrid + Lucerne	225
2. Sorghum + Cowpea - Maize + Cowpea - Maize + Cowpea	111

Selection of various fodder crops/grasses/trees for round the year green fodder production

Annual Legume crops: Berseem, Lucerne, Cowpea, Guar, Rice bean, Velvet bean

Cereal fodder crops: Sorghum, Oats, Maize, Millets, Barley, Mustard (Chinese cabbage)

Perennial Grasses: Hybrid Napier bajra, Guinea grass, Para grass, Congo signal grass and TSH

Range Grasses: Nandi grass, Anjan grass, Blue panic grass, Marvel grass, Rhodes grass

Pasture legumes: Butterfly pea, Stylo, Siratro

Shrubs & trees: Hedge lucerne, Subabool, Siris, Khejari, Shevari, Gliricidia

Conclusion

The review clearly outlines the advantages of intercropping of grasses and legumes, excellent potential of different cereal and legumes like- maize, cowpea, soybean, guar and grasses multiple cropping have variable and better effects on growth, forage yields, quality (crude protein and crude fibre) and adopting the new strategies which help in enhancing in increase the quality and availability of green fodder production. However, the extent of effect varied from region to region, types of crops in association with each other and different row proportions of crops. Under such conditions some alternate has to be developed so as to mitigate the fodder scarcity.

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