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STRATEGIC FODDER RESOURCE MANAGEMENT FOR ENHANCED LIVESTOCK HEALTH AND PRODUCTIVITY IN INDIA

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ABSTRACT

Fodder cultivation had always been less scrutinized sector in agriculture. Major emphasis had always been on cereal or cash crop production. This led to scarcity of fodder resources in India. India attained self-sufficiency in food grain production after advent of Green Revolution but same could not be said about fodder. Neither quality nor quantity of fodder in India is up to the mark which has resulted to continuous sufferings to livestock. Normally animals are fed with locally available crop residue or herbaceous weeds which could not totally satisfy nutrient requirement of the livestock resulting in their poor health. Fodder production had continually increased in the country so is livestock population and livestock population has increased at a rate faster than increase in fodder production rate which has resulted in continuous widening of gap between demand and supply. Strict measures are need of the hour in order to ensure that required quantity of quality fodder is produced in India and suffering of livestock is reduced.

***Keywords*:** Fodder, Livestock, Health, Pastures, Genotypes

Introduction

The agricultural sector in India employs more than 50 per cent of the total workforce and contributes to around 17–18 per cent to the country's total GDP. The value of output from the livestock sector is 28.6 per cent of total value of output from agricultural and allied sectors (Gowane *et al.*, 2019). Livestock sector can play a very important role in poverty alleviation (Sarkar, 2020), According to the National Accounts Statistics (Central Statistical Organisation, 2019), poultry, livestock and dairy are the fastest-growing subsectors in the recent years and the growth in agriculture is to a large extent fueled by the growth of these subsectors.

With the passage of economic development, the demand for animal product has been increasing by each passing day. India became self-sufficient in food grain which is mainly attributed to green revolution resulted in bumper production of foodgrain in the country. But nutritionally we lack behind the minimum standards set by various organisations like FAO and ICMR. A major share of child population in the country still suffers from malnutrition (Ulahannan *et al*., 2022). Our food lacks sufficient amount of nutrients required to fulfil our needs which ultimately lead to malnutrition in major section of the children. Major population in the country is vegetarian, which depend upon plant-based food for all the nutrition uptake (Bhatnagar and Padilla-Zakour, 2021). In their case, use milk and milk products gets even important to supply additional nutrients which could not be supplied through daily food. Even in non vegetarian community, milk helps in supplementing nutrient requirement of the humans. It has all the substances needed by organisms in its easiest assimilable form. Due to its nutritive value, milk is recommended to young and old people (Kandpal *et al.*, 2012).

Demand of milk and milk products is increasing day by day. Increase in demand of milk products is mainly due to urbanisation and rapid increase in population of the country (Vision, 2050). Moreover, with increased awareness in the people of the society people have started consuming milk products more and more. India is currently leading producer of milk in the world with production of 187.7 million tonnes in the year 2018-19 (Anonymous, 2019). But little emphasis has been given on quality of the milk in the country. Poor milk quality is due to poor health status of the milch animal. Inadequate fodder available to the farmers to feed the

livestock is major reason behind poor health of the livestock. Moreover, the fodder being fed to livestock is also poor in quality.

With the Indian livestock depending mostly on crop residues and other low-quality feed and fodder for their survival and production, feed scarcity is the major limiting factor in furthering livestock productivity in India (Bharti *et al*., 2021, Thirunavukkarasu *et al.*, 2011). It has become extremely important to increase productivity of livestock to manage increased demand of the milk and milk products. Demand of milk in the country has increased from 116.3 million tons in 2011-12 to 168.1 million tons in 2020-21 and is further expected to increase up to 209.0 million tons in 2026-27 (Kumar *et al.*, 2014). In order to manage this growing demand, productivity has to be enhanced both quantitively and qualitatively. Best way to increase productivity of the milch animals is by providing sufficient amount of good fodder to them. Fodder should enhance the health of the livestock so that they are able to provide more milk and also nutritional quality of milk will get better. Although population of livestock has been increased especially the population of milch animals but gap between available fodder and required fodder is widening day by day. Furthermore, human population is also increasing at a devastating pace which further put pressure on land resources of the country. Cultivated land is fixed and is getting lesser every year so it has become extremely important to strike a balance between fodder and other agricultural crops. None of the above can be neglected at any cost otherwise mankind will be suffering dearly.

Fodder sector had always been one of the most neglected sectors in the country. Most of development in agriculture has taken place in crops which are directly related to humans. Hence there is very high scope of improvement in fodder production and proper steps taken in this sector will result in superior results. But if major steps are not taken, scarcity of good quality fodder may cost us dearly resulting in catastrophic outcomes for mankind.

Status of Livestock in India

Animal husbandry is an imperative component of farming in India. Farmers engage in rearing of livestock, often as a subsidiary activity, for the supply of milk, meat, wool and manure, or for using them as draft animals (Sannagoudar *et al.*, 2017). India ranks first among the major livestock holding countries having about 15% livestock population of the world, however, milk production of our country is about 17% (Jehangir *et al.*, 2017). India is blessed with diversified type of livestock. Its livestock sector is one of the largest in the world. It has 56.7% of world's buffaloes, 12.5% cattle, 20.4% small ruminants, 2.4% camel, 1.4% equine, 1.5% pigs and 3.1% poultry (Vision 2050). The population of livestock is increasing at a constant rate since independence of India as livestock population was mere 289.4 million in the year 1951 (Sonavale *et al.,* 2020) and according to 20th Livestock census 2019, total livestock population in country has reached 536.76 million. If compared to recent data, livestock population in 2019 is increase of 4.82 % when compared to the population in the year 2012 (512.06 million). Out of total cattle population in 2019, major share is constituted by cattle, buffalos and goats *viz.* 452.19 million which is 84.24 % of total livestock population. Livestock contributes to 7% of national GDP and is source of employment and ultimate livelihood for 70% population in rural areas (Kumar *et al*., 2017a). Livestock sector has been the primary source of energy for agricultural operation and a major source of animal protein for the rural masses. Whole system of Indian rural economy has revolved around livestock production (Raj and Vyakaranahal, 2014).

Livestock have been an integral part of Indian agriculture since time immemorial. In India, traditional agriculture was done with the help of livestock as draft animals. All the labour-intensive work like ploughing of fields, extracting of oil from oilseeds, threshing of cereals like maize, lifting water from wells etc. was done with the help of livestock animals especially male cattle and buffalo. Apart from those, other livestock animals like horse, donkey, camel etc. were widely used for transportation and carrying of goods from one place to another. Their importance in agriculture as draft animals started diminishing with advent of mechanisation in the country. Tractors started taking place of draft animals as work done by tractors was quick and cheap as well. In order to maintain soil health, vermicompost and farm yard manure are widely used in the fields even now. Both of which uses cattle or buffalo dung as basic raw material which can be obtained from livestock only. The importance of farm yard manure was even more before green revolution as that was sole source of nutrients used by farmers at that time. Livestock sector also supplements income from crop production and other sources and absorbs income shocks due to crop failure (Ali, 2007). All of this signifies importance of livestock in animals from past to present.

Nearly 1000 kg of milk is produced by cattle and buffalo per lactation in India while in Europe, US and Israel the value is 4500 kg, 7000 kg and 10000 kg respectively (Ghosh *et al.*, 2016). This show that average productivity of Indian milch animals is far lower than world's leading countries which is matter of great concern. Improper fodder is major reason behind this lower value of productivity in Indian milch animals.

Livestock require sufficient amount of highly palatable nutritious fodder which not only supress hunger of livestock but also enhance their health. This will also reduce the dependency of farmers upon concentrated feed for supplying nutrients to the livestock making it economically convenient to the farmer (Alipatra *et al*., 2012). Year-round fodder availability is also another challenge in livestock industry. A chronic shortage of fodder, most serious in winter, is a major restrictive factor for livestock production. There are two traditional fodder deficit periods are, December to March, when traditional winter fodder crops like oats (*Avena sativa* L.), berseem (*Trifolium alexandrinum*) and lucerne (*Medicago sativa*) are dormant and May to June when the major summer season fodder crops such as maize (*Zea mays* L.) pearl millet (*Pennisetum glaucum*) and sorghum

(*Sorghum bicolor*) have just begun growth and the winter fodder season is over. As a result of deficit periods, green fodder gets available for livestock feeding in late April thereby resulting in drastic reduction in milk and meat production (Jehangir *et al.*, 2013). Fodder availability in dearth/lean period gets very difficult. So, different strategies have to be adopted to manage that like staggered planting of crops, use of hydroponics, use of various tree leaves, preservation of fodder in form of hay or silage etc. Using these methods will result in availability of quality fodder to livestock whole year without compromising their health.

Current Scenario of Fodder Production in India

Green fodder is a very scarce commodity in the country. As livestock population of the country is increasing, demand of fodder is increasing as well. Even now country is facing acute shortage of green fodder and this gap in demand and availability is set to increase in the coming years. India is world's second most populated country with estimated human population of 1.35 billion and it is increasing at an overwhelming rate. It is expected that India will overtake China in upcoming years. Thus, land available for agriculture is expected to shrink as well which will further reduce the fodder production in the country.

Fodder production has been a very neglected sector in the country while major focus has always been on cereal and cash crop production. Due to this negligence, no major breakthrough has been observed in this sector since a long time. Very few varieties are available in the fodder crops even now. Due to which productivity of fodder crops is very low. Due to scarcity of green fodder, animals are usually fed with herbaceous weeds and crop residues instead of dedicated fodder crops which result in poor nutrition to the livestock and ultimately their health suffers. Deficit of the feed and fodder of the anticipated quality has been considered as the key bottleneck in harnessing the potential of the livestock sector in India (Siloriya *et al.*, 2014). Poor health in milch animals directly affect quality of the milk. Their milk lacks recommended quantity of nutritional compounds thus human health is also suffered. Moreover, quantity of milk is also reduced resulting in direct losses to livestock farmers.

There is a constant increase in livestock population in the country. Livestock population has increased from 278 million in 1995 to 333 million in 2020 and expected to reach at 354.8 million in 2030 (Vision 2030, IGFRI). Fodder production in the country has been limited since a long time. The demand of green and dry fodder in the country in 1995 was 947 and 526 million tonnes respectively which has increased up to 1134 and 630 million tonnes respectively in 2020 and is expected to reach 1207.1 and 670.6 million tonnes respectively in the year 2030 (Vision 2030, IGFRI). Thus, demand of fodder is increasing day by day. but fodder production is not at required level which results in widening in gap of demand and supply of the fodder. The deficit of green fodder was 568 million tonnes (59.95 %) in 1995 but it has increased to 728 million tonnes (64.21 %) in 2020 and is expected to reach 790 million tonnes (65.45 %) by 2030 (Vision 2030, IGFRI).

According to Ghosh *et al.* (2016) feed and fodder accounts for nearly 2/3rd of total cost in livestock production. Henceforth, any attempt towards enhancing availability of feeds or fodder, and reducing the feed cost would lead to better remuneration to livestock farmers.

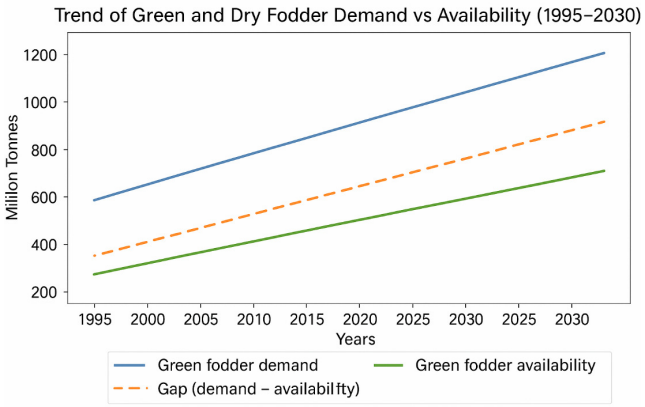

Fig. 1: Trend of green and dry fodder demand and availability over the years (Vision, 2030)

Strategies to Enhance Fodder Production

Proper land utilisation: Proper land utilisation could be an important tool for increasing fodder production without major change in regular agricultural practices. Field bunds can be properly utilised by growing perennial fodder grasses like Bajra-Napier Hybrid (Rathod and Dixit, 2019). They will also act as shelter belts for our regular crops growing in the field by reducing speed of wind and also prevent wind erosion. Apart from this, non cultivated lands can also be ploughed once and then hardy cereal fodders like sorghum, bajra, oat, barley etc could be sown there depending upon season of cultivation. Else, various fodder trees like Subabul (*Leucaena leucocephala*), Babul (*Acacia nilotica*), Siris (*Albigia procera*), Neem (*Azadirachta indica*), Mahua (*Madhuca latifolia*) etc. (Dwivedi and Kumar, 2015) are also widely used as fodder trees and their proper cultivation might result in additional fodder production. This will help in increasing land area under fodder cultivation as well as increasing fodder production.

Improved genotypes: Identification and development of novel planting material is an important requisite for harnessing the complete potential of both cultivated and non-cultivated areas. During last five decades, above 250 forage crops varieties in various fodder crops like berseem, lucerne, oats, pearlmillet, cowpea, *Cenchrus*, Dinanath grass, guar, field bean, guinea grass, *Sehima*, *Chrysopogon*, *Heteropogon* etc. have been released through national network (Ghosh *et al.*, 2016). As land area is fixed, productivity has to be increased in order to increase production of fodder. For increasing productivity, improved cultivars which have good vegetative growth and high yield potential are need of the hour. As climatic stress, pest infestation and diseases are a big hurdle in development of any commodity thus these genotypes should also handle biotic and abiotic stresses properly so that neither harsh climate nor pest or pathogens cause any harm to the crop.

These genotypes should be resistant to major diseases which are supposed to cause losses in the crops.

Nutrient management: Every crop has its own nutrient requirement and fodder crops are not different as well. Every fodder crop has its specific nutrient requirement which needs to be supplemented with the help of manures and fertilizers. One can achieve proper productivity only if crops are fed with required amount of nutrients. Nitrogen plays essential role in the quantitative as well as qualitative enhancement in the productivity of fodder. It is an important component of protein and chlorophyll. It imparts dark green colour to the plants, promotes vegetative and early growth. It also enhances the quality by increasing the protein content of crop and also govern to a considerable degree, utilization of potassium, phosphorus and other essential elements (Dabhi *et al.*, 2017). To meet out the high fodder demand, higher doses of inorganic fertilizers are applied which is both uneconomical for fodder production and continuous indiscriminate use of high dose of chemical fertilizers had deleterious effect leading to decline in productivity due to limitation of one or more micronutrients (Kumar *et al.*, 2017b). Higher use of chemical fertilizers and less use of organic manures and composts, our soils have become deficient in micronutrients. Out of all essential micronutrients iron is especially important due to its vital and indispensable plant growth promoting nature. It plays a significant a role in chlorophyll, chloroplast, enzyme system, pristine synthesis and electron transport during respiration (Singh, 2016). As chemical fertilizers are expensive and not every farmer has purchasing power to purchase chemical fertilizers, integrated nutrient management plays a very important role. The basic concept of integrated nutrient management is the supply of required plant nutrients for sustaining the desired crop productivity with minimum deleterious effect on soil health environment (Jadav *et al.*, 2018). Nutrient supply in crop system should be economically viable, environmentally friendly and socially acceptable without affecting the gross plant production (Kashyap *et al.*, 2017).

Staggered cropping: Instead of sowing whole fodder field at the same time, sowing should be done in parts with 10-15 days interval. This will result in differential maturity of the field which will result in elongated phase of green fodder availability to the livestock. Staggered cropping is most beneficial to reduce lean phase of fodder production by providing longer duration of green fodder availability. Staggered planting from February to September helps cope with the fodder scarcity problems faced in May-June and October-November (Arif *et al.*, 2007). Same can also be done with *Rabi* season crops.

Weed Management: Since scope for expansion of area under fodder crops is very limited, the vertical enhancement is the only solution to the problem of fodder shortage (Kumar *et al.*, 2015). Weeds are the largest hurdle for crop production. It has been estimated that weeds account for about 30-70 per cent losses incurred in agriculture due to due to competition for nutrients, moisture, light and space (Degra *et al.*, 2011). General practice of keeping field weed free in initial $1/4^{th}$ to $1/3^{rd}$ period of crop growth do not goes well with fodder crops as in multicut fodder crops when cut is taken then field is exposed and it give weeds a great opportunity to grow quickly and overtake freshly cut fodder crop. A weed management strategy in which weeds are taken care of even after cuttings is required. Generally, weed management using herbicides is avoided by farmers on account of their toxic effect on animal health but it has been reported that the use of chemical herbicides has boundless scope in fodder crop production as they provide effective weed control and when applied at normal doses, they do not have any adverse effect on palatability of fodder and animal health (Kumar *et al.*, 2015).

Irrigation Facilities: In India, area under fodder cultivation is around 6.91 million hectares contributes about 4.4 per cent of the total cultivated area. Out of this only 1.02 million hectares of land is irrigated (Jat *et al.*, 2015). It can be estimated from the data that maximum fodder cultivation in the country is prone to vagaries of rainfall. In order to increase the productivity of the fodder crops, land under irrigation has to be increased.

Multiple cuttings: Emphasis must be given to those cultivars which have superior regeneration ability so that more cuttings can be taken which will result in higher green fodder production from same crop. Most of cereal or leguminous fodder crops have ability to regenerate after a cutting has been taken from them. If proper cultivar is selected along with proper agronomic management, we might be able to take extra cuttings from that same crop. A general farmers' practice in fodder crops is that they leave the crop for seed production after taking one cut for forage (Sharma *et al.*, 2017). But additional cuttings may be taken in order to enhance forage yield from same crop (Bharti *et al.,* 2023). The availability of green fodder over the season may, then be regulated using cutting management and as regeneration of a crop after frequent cutting may be governed by the genetic makeup of a particular cultivar. Therefore, it will be worthwhile to know the response of the promising cultivars to different cutting managements and to identify the most suitable cultivar that can supply green fodder regularly during crop growing period (Sharma *et al.*, 2019).

Dual purpose fodder crops: Dual purpose fodder crops like wheat, oats, barley etc. not only provide fodder at vegetative stage but after regeneration as well. These can also be left uncut for grain production after taking first cut during early vegetative stage thus obtaining both grain and fodder (Bharti *et al.*, 2024, Singh *et al.*, 2012, Hundal *et al.*, 2014). These crops help in foodgrain production as well as green fodder production. Furthermore, if cultivated properly, fodder obtained from these crops is also of very high quality which will lead to enhanced health of the livestock resulting in better productivity of the animals.

Pasture land management: Natural forages/pastures play a very important role in the livestock based rural economy in developing countries like India (Palsaniya and Dhayani, 2012). Total grazing area in the country is about 40% of the total land area. Out of those, pasture lands constitute the

main grazing resources of the country which are available over an area of 12 million ha *i.e.,* 3.94% of the geographical area (Bisht, 2015). Pastures have been a very good source of forages for the livestock which provide good quality grasses for grazing. Cattle graze there openly and feed as much as required. But lately reduced growth/regeneration of grasses has been observed in the pastures. This is linked to poor nutritional status of the soils of the pasture lands. No proper nutrient management is followed in the pasture lands due to which nutrient reserves of the soil of pasture lands get exhausted resulting in poor growth of the grasses. Nitrogen is an essential primary nutrient for plant growth and plays an important role in productivity of forage crops (Kaur *et al*., 2015). So at least nitrogenous fertilizers need to be applied after each successive grazing so that nutrient reserve of the soil gets replenished in terms of nitrogen ultimately resulting in good growth of the grasses.

Ameliorating grasslands and pastures: Pastures and grasslands are one of the major mismanaged sectors in India. These have been used for livestock grazing since time immorial but little or no care has been taken of them resulting in their degradation. Pasture degradation is referred to the reduction of pasture productivity, which is directly determined by a change in pasture biophysical properties such as biomass, leaf area index (LAI), grass density, and canopy height. These measures are a consequence of complex interactions among pasture management practices, pasture age, edaphic conditions, and climate (Dias Filho *et al*., 2000; Serrão and Toledo, 1990; Numata *et al.*, 2007). But lately due to mismanagement and invasion of problematic weeds, many pastures have been destroyed or become unsuitable for livestock grazing. Invasive weeds like *Lantana camara* have taken over pastures leaving no room for grasses to grow. Moreover, these weeds have thorns which further trouble grazing by the livestock. But if proper care and maintenance is provided to these pastures, they will start producing quality forage again. Proper weed management strategy is required to counter these weeds and once weed population is controlled, more competitive grasses may be introduced in those pastures to limit growth of these weeds.

Preservation of Fodder: During the peak season, fodder is available in abundance but as soon as lean period starts, fodder availability gets severely restricted. In order to avoid this scarcity period, excess fodder available in the peak season may be preserved. Hay and silage are two modern methods of fodder preservation in which fodder is conserved for a long time without much degradation of nutrients. Hay making is a relatively easy process where grassy fodder is quickly sun dried to bring down moisture level at around 30 per cent and then stored in a dry place away from direct rainfall. Silage making is slightly complex method of fodder preservation in which fodder is allowed to ferment anaerobically in the presence of molasses. This result in preservation of fodder without losing any quality. Hence silage and hay making using balers is a practical option when plenty of fodder is available in peak season of crop especially in July-August and in February-March when fodder is available in good quantity (Mehmood *et al.*, 2020).

Proper Data Availability: At the moment there is no agency in the country to provide precise data on fodder production, productivity, adoption of improved varieties and technology for research planning and effective policy formulation. Thus, an agency must be established which will take care of all the data regarding fodder production in the country and will make it available for others to study that as well. The availability of data will give us a better understanding of exact scenario of fodder production in the country and will enable us to correct all the lacunas properly.

Conclusion

Currently green fodder production in the country is far low than required and gap between demand and supply is widening by every progressive day. Fodder is getting scarce day by day and hence health of livestock is suffering dearly. But there is still scope of improvement and by following proper steps, fodder production in the country can be enhanced and other fodder resources can also be ameliorated to produce more grass for grazing. More thrust on research of fodder sector should be given. Innovative practices are required to manage fodder shortfall in the country. New genotypes and better agronomic practices are obligatory to improve productivity of the fodder. Policies should also be formulated for encouraging fodder cultivation so that area under fodder cultivation is increased. Farmers must be made aware of the better economic returns from fodder cultivation that too with lower cost of cultivation than traditional cereal crops resulting in higher B:C ratio. Following such steps will result in significant improvement in fodder production in whole of the country and gap between fodder demand and supply will get diminished. That will lead to better health of the livestock especially milch animals which eventually will lead to better quality and quantity of milk ultimately which will result in better health of humans as well. Improved dairy industry will be a great asset in countering malnutrition in growing children and upliftment of the society.

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