

Assessment of Livestock Feed and Fodder in Gujarat

S. S. Kalamkar, H. Sharma & M. Makwana

All India Study Coordinated by
ADRTC, Institute for Social and Economic Change, Bangalore (Karnataka)



Report submitted to the
Directorate of Economics & Statistics
Department of Agriculture, Cooperation & Farmers Welfare
Ministry of Agriculture & Farmers Welfare,
Government of India, New Delhi

Agro-Economic Research Centre
For the states of Gujarat and Rajasthan
(Ministry of Agriculture and Farmers Welfare, Govt. of India)

Sardar Patel University,
Vallabh Vidyanagar - 388 120, Anand, Gujarat



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AERC Report No. 193

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Draft Report submitted in March 2020
Final Report submitted in March 2020

Citation: Kalamkar, S.S.; H. Sharma and M. Makwana (2020), “Assessment of Livestock Feed and Fodder in Gujarat”, AERC Report No. 193, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat.

Foreword

Gujarat state has made rapid strides in its agriculture sector including the agribusiness sub sector during recent past. Agriculture in Gujarat has been transforming over time from traditional to high value added commercial crops which can be seen from a shift in its cropping pattern from food grains crops to high value cash crops such as oilseeds, fruits, vegetables and spices. The trend in shifting of cropping pattern paved ways for many ancillary industries in the areas of processing, packing, storage, transformation, etc. Agricultural growth in the state is favored by the prevailing eight agro-climatic zones, enterprenuring farming community, policy support from the government, wealth of livestock population, extended coast line and contribution by the agricultural scientist and dedicated NGOs.

About two third of population of Gujarat lives in rural areas and depends for its livelihood on agriculture and the rural non-farm sector that is interlinked with agriculture. Gujarat is traditionally known for its institutions like farmers' cooperatives and other state originations. The Amul model has helped India to emerge as the largest milk producer in the world. Gujarat is a leading state in terms of terms of its quality milch animals and milch production. Gujarat harbours some of the elite breeds of livestock like Gir and Kankrej, Mehsani, Surti, Jafrabadi and Banni buffaloes, Kathiwadi horses, etc. which have high milk yields. Gujarat ranks third position in terms of milk production in the country with the milk production of 122.62 lakh tones which is about 8 per cent of entire country. Major share of motive power of agriculture comes from livestock. Livestock keeping- an integral part of farming system as land, labours and water can be efficiently utilized. An intensive animal vaccination program was launched in all the villages at the '*Krishi Mahotsav*' held since four years, so as to focus on disease management and the rearing of healthy livestock. In addition to vaccinating the livestock, animal health camps were also held.

Though India is the highest milk producer country in the World but milk production per animal per year is very low. Deficiency in quantity and quality of fodder is one of the major cause of this low productivity. The animals need proper feeding to meet their nutrient requirement to express their full genetic production potential. Deficiency of green forage is mainly due to non-availability of land for fodder cultivation. India has vast tracts of grazing land, most of which has fragmented or become degraded due to lack of appropriate policy interventions and management inputs. Fodder are cultivated or grown naturally on degraded and marginal lands with minimum inputs, in terms of fertilizers water and operational energy. Moreover, in case of forages, regional and seasonal deficiencies are more important than the national deficiencies, as it is not economical to transport the forage over long distances.

The marginal and small farmers own only 44 per cent of the agricultural land while they own 80 per cent livestock assets. Quite logically, if the income of the farmer is to be doubled by 2022 as per the vision given by the Hon Prime Minister in 2016, then livestock is perhaps the best and most available assets to enhance farmers

income due to higher availability of the livestock as compared to land as an asset for income generation. While overall productivity of livestock has been low in past, because of inadequate nutrition from green fodder, along with dry residue and protein concentrate. As per NIANP (ICAR) estimate, there is shortage of up to 36 per cent of green fodder and protein concentrates besides up to 23 per cent shortage of dry fodder. In view of same, the Ministry of Agriculture and Farmers Welfare, Government of India entrusted this study to our Centre. The study is based on both primary and secondary level data. The study came out with important and relevant policy implications which would help to plan to increase the area under fodder cultivation and milk production in the country and also doubling the income of the dairy farmers.

I am thankful to authors and their research team for putting in a lot of efforts to complete this excellent piece of work. I also thank the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India for the unstinted cooperation and support. I hope this report will be useful for policy makers and researchers.

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Acknowledgements

The study on “Assessment of Livestock Feed and Fodder in Gujarat” has been carried out at the Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat, as entrusted by the Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.

We have benefited immensely from various scholars and officials from different government departments while carrying out this study. At the outset, we would like to thank Prof. Shirish Kulkarni, Vice Chancellor of our University and Chairman, AERC Governing Body as well as Dr. Mahesh Pathak, former Honorary Advisor of our Centre for their constant encouragement and support for undertaking such research activity at the Centre. We are grateful to the coordinators of the study, Dr. I. Maruthi, Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore, Karnataka for providing required support, study framework and necessary inputs in completing the study.

We thank Shri B. M. Modi, present Director of Agriculture; Dr. Hitaben Patel, Director of Animal Husbandry, Department of Agriculture and Cooperation, Govt. of Gujarat, Krishi Bhawan, Gandhinagar (Gujarat) for providing the secondary level information related to crop production and livestock in the state of Gujarat.

The study would not have reached to this stage without the active co-operation of the respondent milk producers from selected villages in Gujarat who provided all the required data for the study without any hesitation and expectation. We thank each one of them for their invaluable support.

We also thank the constructive comments/suggestion given by the Dr. I. Maruthi, Professor, Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore, Karnataka on the draft report.

We have also received support and encouragements from our colleagues in the Centre while carrying out the study. We would specifically thank Dr. Kinjal ahir, Deputy Director (Hon) of AERC & Associate Professor, PG Department of Economics of our University; and Dr. S. R. Bhaiya, Field Officer, CCS for Gujarat of our University for their support during field work of the study. We are thankful to Shri T. B. Parihar, Ms. Kalpana Kapadia for collecting data from the field and government/dairy union offices.

Thank to Shri Deep Patel (Research and Reference Assistant-Lib) for designing the cover page of report and making necessary arrangements for printing and circulation of the report.

Lastly but not least, we thank the all other AERC staff for their direct and indirect support.

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List of Abbreviations

Av.	- Average
CAGR	- Compound Annual Growth Rate
CB	- Cross Breed
CP	- Crude Protein
DADF	- Department of Animal Husbandry, Dairying and Fisheries
DCS	- Dairy Cooperative Society
DES	- Directorate of Economics and Statistics
Dist.	- District
DM	- Dry Matter
FAO	- Food and Agriculture Organization
FASR	- Food & Agribusiness Strategic Advisory & Research
GCA	- Gross Cropped Area
GDP	- Gross Domestic Product
GOG	- Government of Gujarat
GOI	- Government of India
GSDP	- Gross State Domestic Product
GVA	- Gross Value of Agriculture
GVO	- Gross Value of Output
ha	- Hectare
HH/hh	- Household
HYV	- High Yielding Variety Seeds
IGFRI	- Indian Council of Agricultural Research
kg	- kilograms
LRP	- Local Resource person
LTPD	- Litres per day
mha	- Million hectares
MOA	- Ministry of Agriculture
mt	- Metric Tonnes
NATP	- National Agricultural Technology Programme
NCAER	- National Council of Applied Economic Research
NCDFI	- National Cooperative Dairy Federation of India
NDDB	- National Dairy Development Board
NDP	- National Dairy Plan
NITI	- National Institution for Transformation India
Nos	- Numbers
NSDP	- Net State Domestic Product
NSSO	- National Sample Survey Organization
RLU	- Ruminant Livestock Units
Rs.	- Rupees
SAP	- State Agriculture Plan
SAU	- State Agricultural Universities
SC	- Scheduled Caste
ST	- Scheduled Tribe
TDN	- Total Digestible Nutrients
TL	- Truthful Seeds
VOO	- Value of Output

Executive Summary

Assessment of Livestock Feed and Fodder in Gujarat

S. S. Kalamkar, H. Sharma & M. Makwana¹

1. Introduction:

Animal husbandry in India is closely interwoven with agriculture. It plays an important role in the socio-economic development of millions of rural households thereby contributing importantly in the national economy. Livestock rearing is one of the most important economic activities in the rural areas providing supplementary as well as stable income round the year. This sector has also emerged as a vital sector for ensuring a more inclusive and sustainable agriculture system. Evidence from the National Sample Survey Office's (NSSO) 70th round survey (2014 & 2014a) showed that more than one-fifth (23 per cent) of agricultural households with very small holdings of land (less than 0.01 hectare) reported livestock as their principal source of income. More than 70 million of the reported 147 million rural households depend on dairy, in varying degrees, for their livelihoods. Marginal, small and semi-medium farmers with average operational holdings of area less than 4 ha own about 87.7 per cent of the livestock of India. By controlling 64 per cent of the bovine, 70 per cent of ovine, 73 per cent of caprine and 70 per cent of the poultry population, the small holders contribute substantially to livestock production. Dairying has become an important secondary source of income for millions of poor and rural households and has assumed an important role in providing employment and income generating opportunities particularly for marginal and women farmers. This is the sector where the poor contribute to growth directly instead of deriving benefits from growth generated in other sectors of the economy. This sector has created a significant impact on equity in terms of employment and poverty alleviation as well. It cannot be merely a co-incidence that the level of rural poverty is significantly higher in states where livestock sector is underdeveloped.

2. Need for the study

Dairy Industry in the country has shown spectacular growth during the last few decades. With an expected production of about 188 million MT of milk by the end of 2018-19, it is estimated that annual requirement of green fodder will be to the tune of 1,100 million MT and dry fodder to the tune of 610 million MT. The current availability of green and dry fodder, however, is estimated at 500 million MT and 380 million MT respectively. Efforts to increase livestock productivity / production is constrained by feed /fodder shortages. The shortages tend to be even more serious during natural calamities. To improve the availability of fodder, there is very little scope to increase the area under fodder cultivation, particularly in view of the growing demand of human beings for food, fiber and shelter. It is therefore necessary to increase the availability of fodder by increasing the productivity of available forage resources per unit area, improve the efficiency of fodder utilization and minimize the fodder wastages to increase and thereby reduce the gap between demand and supply. The present average green fodder yield of 40 MT/hectare/year of cultivated land and 0.75 MT/hectare/year for common grazing land are too low and there is huge potential to improve their productivity through adoption of latest technologies.

The country's estimated demand for milk is likely to be about 200 million tonnes in 2021-22 (NDDB, 2014 & 2014a). To meet the growing demand, there is a need to increase the annual incremental milk production from 4 million tonnes per year as was the case for the last

¹ Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Anand, Gujarat

10 years to 7.8 million tonnes in the next 8 years (total 210 million by 2021-22). To meet the growing demand, it is necessary to maintain the annual growth of over 4 per cent in the next 15 years. Quantum jump in milk production is possible through increase in productivity, and linking small holders to dairy cooperatives/producer groups/SHGs with forward linkages having milk processing facilities. Adequate availability of feed and fodder to livestock is vital to increase their productivity and also to sustain ongoing genetic improvement initiatives. The supply of feeds has always remained short of normative requirement. The situation is further aggravated in Rajasthan and Gujarat where considerable area falls in arid and semi-arid zones. Keeping this background, the study examines demand, supply, and a deficit of feed and fodder production in the Gujarat.

3. Data and Methodology:

The study is based on both, the secondary and primary level data. The study is based on both secondary and primary level statistics. The secondary data on livestock population of all selected states are compiled from published sources. To understand and analyze the demand for and supply of feed and fodder, primary data were collected from the field level through a sample survey method. As per the sampling framework, data were collected from three selected districts from three regions of the state, i.e. Banaskantha (North Gujarat), Surat (South Gujarat), and Panchmahal (East Gujarat). The reference period of the study was 2019-20 agricultural year.

4. About Study Area:

Gujarat has been consistently clocking impressive agricultural growth rates. This has been possible because the government has focused on improving not only irrigation, quality of seeds and power but also subsidiary sectors like animal husbandry. The growth of the animal husbandry sector has resulted not only in increased milk production but has also provided a boost to the overall agro-economy of the state. The livestock sector in Gujarat has achieved a remarkable success during last six decades due to collective efforts of government organisations, non-government organisation and the milk producers. Gujarat is one of the leading states in terms of milk production. The cooperative sector has been the key driver of the tremendous increase in Gujarat's milk production. It is not a surprise that Gujarat, the birthplace of India's white revolution, has a thriving milk cooperative sector. The largest dairy co-operative in India, Amul, is based in Anand, Gujarat. 'Amul' pattern is well known & accepted by all states in India besides some of the countries in the world.

Animal husbandry has played a significant role in boosting the agrarian economy of the state. It is not only a subsidiary source of livelihood in rural Gujarat, it is a major economic activity, especially in the arid and semi-arid regions of the state. Thus, this sector plays a vital role in the rural economy of the state and has significant impact on employment generation for marginal, sub-marginal and landless farmers. Out of about total 102 lakhs household, about 43 lakh households have livestock in Gujarat as a primary or secondary source of income. Milk contributes around 20 per cent to the agricultural GSDP of Gujarat and is one of the biggest sectors for supporting livelihood in the state. Share of milk in livestock output at constant prices was about 86 per cent, which was not only the highest contribution but also was a noticeable share in the total livestock output.

Gujarat State has secured a remarkable position in the country as far as livestock wealth and development are concerned. As per Provisional figures of the 20th Livestock Census (2017) of India, 26.9 million livestock (5.02 % of all India) population was in the state of Gujarat. An increase in livestock population from 23.51 million in 2007 to 27.12 million in

2012 was observed and then declined between 2012 and 2017. In fact, the share of Gujarat in all India total stock of livestock increased by 0.86 percent points during 2007 to 2012 and then declined by 0.28 percent points in 2017. As per Livestock Census 2012, among various species in Gujarat livestock, buffalo comprised of the highest share (38.28 per cent) in total livestock population followed by Cattle (36.80%), Goat (18.28 %) and Sheep (6.30 %), besides marginal share of other livestock species such as Camel, Mules, Donkeys, Horses and Ponies. Banaskantha (9.38 %) had the highest number of livestock population followed by Panchmahal (7.41%), Kachchh (7.14%), Sabarkantha (6.8%), Dahod (6.41%) and Vadodara (6.13%). These six districts together accounted for 44 percent of total livestock population in the state in 2012.

Gujarat is a leading state in terms of its quality milch animals and milk production. Gujarat ranks third among the milk producing states in India, with 144.93 lakh MT in 2018-19, an increase from the 30.9 lakh tonnes in 1983-84. Despite of increase in milk yield, there is still a wide scope for improving milk yield of milch animals. The reason cited for this is inappropriate feeding as well as inadequate supplies of quality feeds and fodder in addition to the low genetic profile of the Indigenous breeds. It is not possible to achieve higher productivity in milching animal by merely increasing its genetic potential. Due attention needs to be given to proper feeding of milching animals. There is no shortcut to sustain livestock husbandry, without addressing the development of fodder and feed resources.

As such there is lack of time series dataset regarding area under forage and fodder crops in India. While GOG 2018 (SAP & SIDP) report has highlighted area under forage crops in Gujarat which was estimated to be 2.32 lakh ha in the year 2017-18 in Gujarat. Out of the total area under forage crops in Gujarat, about one fourth of total area was in Banaskantha district followed by Mehsana having about 10 per cent of total area in the State. Other districts, having around 5 per cent area under forage crop, were Vadodara, Sabarkantha, Kachchh and Kheda. As against the estimated animals' requirements, feed resources available in Gujarat are lower. During the period 2003 to 2011, shortage of fodder was observed in the state. In context of dry matter, a reduction was observed from 137 per cent of the requirement to 66 per cent; total digestible nutrients from 200 per cent to 73 per cent while the crude protein availability increased from -98 per cent to a surplus of 19 per cent.

5. Findings from Field Survey:

- The various socio-economic factors for instance size of family, education and training of dairy producer, availability of land and off farm income, experience in dairy, etc have direct influence on dairy farmers' decision to whether they want to expand and improve their dairy operations. Average age of the selected household head/respondent was around 46 years of which almost half of them found to be illiterate. The remaining half of the household respondents were educated mostly up to the highest level of high schools except few of them were found graduated. Out of the total selected respondents, almost 46 per cent were from backward classes, followed by around 28 per cent from Scheduled Caste, 14 per cent from Schedules Tribe and rest of them belongs to open category. Most of the selected households respondents were male (92 per cent) and very few (8 per cent) were female respondents.
- The selected households had relatively higher experience in dairy business (20 years) followed by farming (18 years) and sheep and goat rearing (10 years). The average family size was found to be 6.66 persons and the highest share of family members were found to be primarily engaged in dairy business (44 per cent) followed by 36 per cent in farming and rest of them were in sheet and goat farming. The main occupation of the selected households was agriculture comprised of cultivation of land as a farmer along with supportive allied activity of animal husbandry and dairying. Agriculture was the primary occupation of 55 per cent households followed by animal husbandry

and dairy (22 per cent) and around 12 per cent were depends on labour activities. Own farm establishment and self employment were other major sources of occupation. The annual average income of the selected households was estimated to be Rs. 105756/- followed by Rs. 78705/- from dairy, Rs 6610/- from sheep and goat rearing. Around 73 per cent of the selected households were found be a member of social and cooperative organisations.

- On an average, operational land holding was estimated to be marginal size of holdings having 0.91 ha of which 92 per cent land was irrigated. It was very surprising and pleasant to note that almost 44 per cent of total operational holdings was devoted to fodder crops, while same was very significant in case of land under rainfed condition (72 per cent) as compared to 42 per cent land was under fodder by irrigated land holders. The groundwater the main source of irrigation followed by surface sources such as canal and tank.
- The cropping pattern of the selected households indicates that highest area under fodder crops was recorded during kharif and rabi season. Besides, during kharif seasons, supportive crops which by product can be used as fodder crops such as maize, bajra, moong, urad and groundnut were grown. The fodder cultivation is found to be relatively less profitable than other crops.
- The details on fodder and feed fed to the animals indicate that the more than 93 per cent selected buffalo and Cattle had average age of more than 2 years while around two fifth of sheet and goats were of same age. The average value of sheet and goat for the age of 2 years and above ranges between as high as around Rs. 6821/- and Rs. 6593/- in Banaskantha and as lowest as Rs. 1020/- in Panchmahal district and Rs. 1873 in Surat district, respectively.
- The average value of the buffalo, crossbreed cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 48000/- , followed by Rs. 39000/- for crossbreed cattle and Rs. 30000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Banasskantha and Panchamal district than Surat. The average value of animals as per stage of life i.e. heifer not pregnant, heifer pregnant, dry and mulching animals.
- The details on the fodder and feed fed to the milch animals indicate that the average feed and fodder consumption of milch animals was ranges between 14- 16 kg of green of fodder followed by 12-14 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed to the adult animals. The quantity of feed and fodder fed to the animals were significantly high for milch animals followed by the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day. The small ruminants were mostly fed outside by taking out for grazing and very few of the households had fed them with the dry fodder and some concentrates. On an average, animals were also taken out for grazing for 7-8 hours on each day.
- The total requirement of feed and fodder using the standards given by the NATP database and as per the available data of livestock census of 2012 was to be 85062 tonnes of green fodder, 415411 tones of dry fodder and 289746 tones of concentrates per day. With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data of the State of Gujarat for the year 2016-17 and was estimated to be 71277 tonnes. The main crops residues available for livestock in the state are Bajra, Paddy, Wheat, Pulses, Oilseeds and Sugarcane. The percent gap between the requirement and availability has been computed which indicate that State is deficit in dry fodder followed by availability of concentrates. The green fodder was estimated to the by 30 per cent than requirement.

- The major sources of livestock feed reported by the sample households are crop residues was major source of the livestock feed followed by grazing land. Half of the respondents depend on the improved forage and pastures, household left over and tree legumes grown as hedge. Very few household have reported use of feed preserved feed in storages. Very few households have cattle shed and majority of them are kuccha in nature of which few are within house. While in case of shed for sheep and goat, very few of same of kaccha nature.
- As dairy activities are carried out as complimentary activity to agriculture activities, the labour use pattern by the selected sample households indicate the significant involvement of female in dairy activity (buffalo, crossbred cows and indigenous cows) while in case of sheet and goats, male were engaged may be mostly for grazing them on the field. The time spent on management of dairy business for the stall feed animals was estimated to be around 2-3 hours per day while same was about 3-5 hours for small ruminants. The net returns realised by the sample households shows that the highest milk yield realised by the sample households from buffalo (9.22 lit/day) followed 5.82 lit/day from buffalo and 5.17 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be less than a litre per day. Therefore, there is a huge scope to enhance producers' income from dairy by enhancing animals productivity, improving management practise, and ensuing remunerative prices.
- The details on constraints faced by the sample households indicate that the top most constraint faced as expected was small size of land holdings and therefore selected households cannot afford to put more land under fodder seed/crop production as they need to grow food grains and commercial crops. The other major constraints reported are no provision of quality seed by society on credit & Non availability of quality fodder seed in market; High Cost of Cultivation/Production and Low return on fodder production; non-availability of Grazing lands; and non availability of adequate irrigation water.
- The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be sued during off seasons. It was very strange to note that despite of the fact that fodder availability has direct relation with milk productivity as well as health of the animals, almost all the households had not adopted any post harvest technique, which indicate failure of the agricultural extension mechanism/department of animal husbandry in training the farmers for such techniques (e.g. hay making, silage, etc). The major reasons for non adoption of these post harvest techniques were highly expensive to adopt the post harvest techniques (55 per cent), followed by lack of awareness on production and post harvest management (29 per cent) and considered it inferior in comparison to fresh one (14 per cent) and more laborious (2 per cent).
- It was strange to note that hardly 3 per cent of total households have reported that they have benefited from government and dairy cooperative having availed cattle shed subsidy, fodder seed and loan of purchase of livestock as well as free medicine and availability of feed at dairy cooperative. Almost 97 percent of households reported that they did not received any support from the government net or dairy. The top three suggestions made by the selected households were availability of quality seed in time, seed availability at subsidised rate.

6. Conclusions and Policy Recommendations:

- Animal husbandry plays a vital role in Gujarat's rural economy contributing 5.32 per cent to the state GSDP in 2013-14, while the contribution of agriculture to total GSDP was 16.83 per cent. Milk contributes around 20 per cent to the agricultural

GSDP of Gujarat and is one of the biggest sectors for supporting livelihood in the state. This suggests that public investment in the livestock sector should be enhanced to help the smallholder livestock producer, which derives their larger share of income from the livestock sector.

- Dairy industry can serve as a cushion in the form of continuous flow of income as an industry complementary to the agricultural industry. While both agriculture and dairy industry if simultaneously operate it can improve not only farmer's income but also compensate for unexpected losses faced due to agriculture especially for poor small and marginal farmers. Besides such complementarily protects against seasonal and disguised unemployment and acts as a shield to protect farmer against the negative impact of climate change on agriculture.
- Shortage of quality dry fodder and concentrates is major constraint for livestock sector growth. The gap between the requirement and availability of feed and fodder is increasing due to decreasing area under fodder cultivations and reduced availability of crop residues as fodder. Also there is continuous shrieking of common property resources leading to over grazing on the existing grass land. Therefore, there is a need to work out the strategies for sufficient good quality feed and fodder for efficient utilisation of genetic potential; of the various livestock species and for sustainable improvement in productivity.
- Improvement in nutritional rationed balanced diet can create a positive impact on yield thereby improving net income and optimum use of available fodder and feed with households. Ration Balancing Program (RBP) results in better health of animal, improves the milk composition and the yield, improves conception rate and thereby lactation cycle improves due to reduction in the dry rate. Hence it is suggested that if the local educated youth of the village are involved in the form of Local Resource Persons (LRPs) it would result in the optimum utilization of the locally available resources in the form of fodder and labor as also the rural employment rate will improve. In the process such positive interventions would have multifold effect in net dairy income and reduction in the quantity of BEP through reduction in cost and improvement in income through improved quality of milk. Such benefits can be assured through proper assessment mechanism form RBP.
- Fodder forms a major component of the variable cost in the dairy industry. If the feed and fodder cost is reduced it can result in improvement in net income and reduce the BEP quantity.
- Fodder is the major component of the variable cost. Hence fodder community farming farms should be encouraged, benefits assessed, and should be effectively communicated to the dairy farmers. Co-operative farming of fodder particularly on the barren land of the village can assure sufficient local availability of the fodder and thereby reduce the variable cost, create a positive impact on net income.
- The co-operative structure is very weak in Saurashtra and Kachchh regions of the state. Therefore, presence of Milk Producer Company's sales & distribution network is spread across Saurashtra & Kutch region support the dairy development in this regions. Therefore, there is a need to support the MPCs in all the areas for balanced development of dairy sector.

Chapter I

Introduction

1.1 Introduction

Animal husbandry in India is closely interwoven with agriculture. It plays an important role in the socio-economic development of millions of rural households thereby contributing importantly in the national economy (Vaidyanathan, 1989; Mishra, 1995; Chawla, *et al*, 2004; Sharma, 2004; Birthal, 2016). Livestock rearing is one of the most important economic activities in the rural areas providing supplementary as well as stable income round the year. This sector has also emerged as a vital sector for ensuring a more inclusive and sustainable agriculture system. Evidence from the National Sample Survey Office's (NSSO) 70th round survey (2014 & 2014a) showed¹ that more than one-fifth (23 per cent) of agricultural households with very small holdings of land (less than 0.01 hectare) reported livestock as their principal source of income. More than 70 million of the reported 147 million rural households depend on dairy, in varying degrees, for their livelihoods. Marginal, small and semi-medium farmers with average operational holdings of area less than 4 ha own about 87.7 per cent of the livestock of India. By controlling 64 per cent of the bovine, 70 per cent of ovine, 73 per cent of caprine and 70 per cent of the poultry population, the small holders contribute substantially to livestock production (NSSO, 2014). Dairying has become an important secondary source of income for millions of poor and rural households and has assumed an important role in providing employment and income generating opportunities particularly for marginal and women farmers (Patel, 2003). This sector has created a significant impact on equity in terms of employment and poverty alleviation as well. It cannot be merely a coincidence that the level of rural poverty is significantly higher in states where livestock sector is underdeveloped (Singh and Meena, 2012). This is the sector where the poor contribute to growth directly instead of deriving benefits from growth generated in other sectors of the economy.

In many cases, livestock is also a central component of risk management strategies for small holders (Randolph et al., 2007). It serves as a substitute of

¹<http://dadf.gov.in/about-us/divisions/cattle-and-dairy-development>

insurance. It has been witnessed over the years that the stability in dairy income is far stronger than the income realised from agricultural activities (Kumar and Shah, 2016). Livestock is a natural asset for poor that can be liquidated when required or during times of crisis (Singh and Meena, 2012). It also helps in controlling migration as well as suicides. It is estimated that this sector generates 5-6 per cent of total rural employment (Shah, 2019), provides regular employment to 9.8 million people as a principal occupation and 8.6 million people as a subsidiary occupation. More importantly, women constitute 71 percent of the labour force in livestock farming (GOI, 2002). Apart from providing subsidiary income (about 12 per cent of rural household income, while 26 per cent in case of the poorest household), rearing of livestock is a source of nutrition for rural households in the form of milk, eggs and meat. Milk has always played a critical role in addressing hunger and malnutrition (Kumar, 2016).

Livestock sector is the second most important contributor to the agricultural economy of India, next only to staple crops. Animal husbandry and dairying sector contribute about 25.8 percent to the Gross Value Added (GVA) from total agriculture, forestry and fishing sectors. Its overall contribution to the total GVA of India was about 4.6 per cent in 2016-17, at current prices. The share of GVA of livestock sector to total agriculture (crops & livestock) has increased from 23.8 per cent in 2011-12 to 26.2 per cent in 2016-17 at constant prices. At current prices, same share has increased from 22.0 per cent in 2012-13 to 25.8 per cent in 2016-17 as depicted in Table 1.1.

Table 1.1: Percentage contribution of Livestock in Total Agriculture GVA

Year	GVA at Constant(2011-12) Basic Prices					GVA at Current Basic Prices				
	GVA-Agri		GVA-livestock			GVA-Agri		GVA-livestock		
	Rs. In Cr	% to total GVA	Rs. In Cr	% to total GVA	% to Ag.	Rs. In Cr	% to total GVA	Rs. In Cr	% to total GVA	% to Ag.
2011-12	1501947	18.53	327334	4.04	21.79	1501947	18.5	327334	4.04	21.79
2012-13	1524288	17.84	344375	4.03	22.59	1675107	18.2	368823	4.01	22.02
2013-14	1609198	17.75	363558	4.01	22.59	1926372	18.6	422733	4.08	21.94
2014-15	1605715	16.53	390449	4.02	24.32	2093612	18.2	510411	4.44	24.38
2015-16	1615216	15.38	421369	4.01	26.09	2225368	17.7	584070	4.65	26.25
2016-17	1716746	15.26	448964	3.99	26.15	2484005	17.9	639912	4.62	25.76

Source: GOI (2018), www.dahd.nic.in.

The dairy subsector occupies an important place in the livestock sector and in the agricultural economy of India since milk is the second largest agricultural commodity contributing to Gross National Product (GNP), next only to Rice. While about two third of total value of output from livestock sector during 2017-18 was

accounted by milk group followed by about one fifth share by meat group, the use of dung as fuel with a contribution of 5.4 per cent also significantly contributed in total value derived from livestock sector at current prices as shown in Table 1.2.

Table 1.2: Value of Output from Livestock Sector (at current prices)

Sr. No.	Item	Value of Output from Livestock sector (at current prices)							
		2011-12		2015-16		2016-17		2017-18	
		Rs. Crore	% to total	Rs. Crore	% to total	Rs. Crore	% to total	Rs. Crore	% to total
1	Milk Group	327767	67.2	560823	67.3	629157	66.2	701530	67.2
2	Meat Group	96219	19.7	171636	20.6	207245	21.8	218540	20.9
3	Eggs	16633	3.4	26657	3.2	29756	3.1	32844	3.1
4	Dung	6.7	6.7	5.8	5.8	5.6	5.6	5.4	5.4
5	Increment in stock	9710	2.0	17757	2.1	21590	2.3	24623	2.4
	VOO (Livestock)	487751	100.0	833498	100.0	950892	100.0	1043656	100.0

Source: www.nddb.coop

India is endowed with a significant proportion of the world's livestock population (Prabaharan, 2002; Sharma and Sharma, 2002). India ranks first in terms of cattle and buffalo population in the world. The population of cattle and buffalo in India was 218 million and 115 million in 2012 respectively, which accounted for 14.7 per cent and 58 per cent share respectively of world cattle and buffalo population. Most of these are milch cows and milch buffaloes. However, milk productivity of these animals is very low that might be due to malnutrition. Shortage of quality of fodder and the scarcity of feed are impending constraints in improving livestock productivity (BIRTHAL and JHA, 2005).

India inhabits about 17.79 percent of world human population with 15 per cent of world livestock population on 2.4 percent of geographical area. With only 4.2 per cent of the world water resources the natural resources of India are under considerable strain. Due to ever increasing pressure of human population, arable land is mainly used for food and cash crops, leaving lesser proportion of good quality arable land for fodder production. Despite of the fact that there is a scarcity of total feed and fodder, land available for fodder production has been decreasing. Land allocation to cultivation of free fodder crops is limited and has hardly ever exceeded 5 per cent of the gross cropped area resulting in a severe deficit of green fodder, dry fodder and concentrates. Availability of adequate quantity of feed and fodder for livestock is essential for improving the livestock productivity. NITI Ayog in their 'Three Year Action Agenda 2017-2020' emphasised on shift into high value commodities, have

indicated that an important challenge in development of animal husbandry is concerned with fodder availability (GOI, 2017a). Thus, feed availability needs to be ensured if livestock is to be sustained at farm level (Biradar and Kumar, 2013).

1.1.1 Dairy Development in India

Dairy development in India has been acclaimed as one of the most successful development programmes under the world's largest integrated dairy development programme 'Operation Flood' (Shiyani, 1996; NAAS, 2003). India ranks first in the world² in milk production (19.6 % of world's milk production). Milk production has increased to 187.7 million tonnes in 2018-19 (from 17 million tonnes in 1950-51) and it is targeted to produce 300 million tonnes by 2023-24 (GOI, 2017, www.nddb.coop). Nearly 49 per cent of milk production was contributed by buffalo followed by cow (47%) and goats (4%) in 2017-18 (GOI, 2018).

While more than 75 million households in India are engaged in dairy farming, about 16.6 million farmers have been brought under the ambit of 1,85,903 village level dairy corporative societies up to March 2017 (<http://dahd.nic.in>). The dairy co-operatives have created a positive impact on the social and economic life of the people in the respective region/state. The impact of the 'White Revolution' can be seen in the villages in the form of generation of funds for community development and social welfare, creation of self-employment opportunities, ensuring distributive justice and removal of the evil of untouchability. This silent social revolution has been relatively smooth and hence even unnoticed by the conservative community. The dairy cooperative movement has been central to the development of dairying in India. The inspiration for this movement was the success of the *Khaira* District Cooperative Milk Producers Union (KDCMPU) known as 'Amul'. The 'white revolution' was driven by demand (Delgado et al., 2001); starting with the cooperative milk producers union, Amul (mainly women) in Anand (Khaira district of Gujarat). Founded in 1946, in response to the exploitation of districts dairy farmers, Amul grew rapidly from its initial base of two societies and two hundred litres of milk. The Amul model has helped India to emerge as the largest milk producer in the world. More than 16.57 million milk producers poured milk in 1.86 lakh dairy cooperative societies across the

² Forecast by FAO indicate that the world's milk production in 2016 would be 817 million tonnes, while that of India would be 160.4 million tonnes (NCAER, 2017).

country in 2017-18. The milk was processed in 184 District Co-operative Unions and marketed by 22 State Marketing Federations, ensuring a better life for millions.

The Amul Model of dairy development is a three-tiered structure with the dairy cooperative societies at the village level federated under a milk union at the district level and a federation of member unions at the state level. Dairy cooperatives account for the major share of processed liquid milk marketed in the country. Milk is processed and marketed by milk producer's cooperative unions, which federate into state cooperative milk marketing federations. That growth, however, posed a challenge that threatened its existence as flush season production of milk exceeded the demand. Yet the cooperatives success depended on accepting the farmer milk year round. An institution of national Importance i.e. National Dairy Development Board (NDDB) was established in Anand, Gujarat by the Act of Parliament in 1965 for the dairy development in India. Also a Federation of Cooperative Societies (National Cooperative Dairy Federation of India - NCDFI) was formed which is located at Anand, Gujarat. NDDB Dairy Services (NDS) was incorporated in 2009 as a not-for-profit company under Section 8 of the Companies Act to function as a delivery arm of NDDB for field operations related to promoting producer companies and productivity enhancement services.

1.1.2 Growth and Compositional Changes in Livestock Population in India:

India holds more than a quarter of world's bovine population (Kishore et al., 2016). From 1951 to 2012, livestock population in the country increased significantly from 292.8 million to 512.1million (Table 1.3). However in the recent past, the total livestock in the country registered a decline from 529.70 million in 2007 to 512.1 million in 2012. There were some changes in the composition of livestock at national level in broad groups like bovine, ovine and other livestock during the last six decades. The proportion of bovine population (includes cattle and buffalo) declined from nearly 68 per cent in 1951 to 58.5 per cent in 2012, while the proportion of ovines (sheep and goat) increased from about 29.5 per cent in 1951 to 39.11 per cent in 2012. The share of other animals also decreased from 2.7 per cent to 2.4 per cent during corresponding period. The population of bovine stock consisting of cattle and buffalo increased at zero rate during 1992-1997 and then registered decline in 2003, increased in 2007 and then again declined in 2012. Between these two species, stock

of buffaloes increased at a much faster rate than that of cattle population indicating the rising importance of buffaloes because of higher price for buffalo milk, and substitution of drought animals with mechanical power in the country. The livestock density per hectare of net sown area has increased from 2.45 in 1951 to 3.42 in 1997 and 3.63 in 2012.

Table 1.3 : Livestock Population in India by Species (in million numbers) for 1951-2012

Species	Livestock Population in India by Species (In Million Numbers)												
	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	2003	2007 #	2012
Cattle	155.3	158.7	175.6	176.2	178.3	180	192.5	199.7	204.6	198.9	185.2	199.1	199.9
Adult Fe Cattle	54.4	47.3	51	51.8	53.4	54.6	59.2	62.1	64.4	64.4	64.5	73.0	76.7
Buffalo	43.4	44.9	51.2	53	57.4	62	69.8	76	84.2	89.9	97.9	105.3	108.7
Adult FeBuffalo	21	21.7	24.3	25.4	28.6	31.3	32.5	39.1	43.8	46.8	51	54.5	56.6
Total Bovine	198.7	203.6	226.8	229.2	235.7	242	262.2	275.7	288.8	288.8	283.1	304.4	299.6
Sheep	39.1	39.3	40.2	42.4	40	41	48.8	45.7	50.8	57.5	61.5	71.6	65.1
Goat	47.2	55.4	60.9	64.6	67.5	75.6	95.3	110.2	115.3	122.7	124.4	140.5	135.2
Horses, Ponies	1.5	1.5	1.3	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.6	0.6
Camels	0.6	0.8	0.9	1	1.1	1.1	1.1	1	1	0.9	0.6	0.5	0.4
Pigs	4.4	4.9	5.2	5	6.9	7.6	10.1	10.6	12.8	13.3	13.5	11.1	10.3
Mules	0.1	0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2
Donkey	1.3	1.1	1.1	1.1	1	1	1	1	1	0.9	0.7	0.4	0.3
Yak	NC	NC	0	0	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1
Mithun	NA	NA	NA	NA	NA	NA	NA	NA	0.2	0.2	0.3	0.3	0.3
Total Livestock	292.9	306.6	336.5	344.5	353.2	369.4	419.6	445.2	470.9	485.4	485	529.7	512.1
Poultry *	73.5	94.8	114.2	115.4	138.5	159.2	207.7	275.3	307.1	347.6	489	648.8	729.2

Notes: NC: Not Collected; NA: Not Available; *Includes Chicken, ducks, turkey & other birds; #Provisional-village level totals.
Fe-Female.

Source: GOI (2016).

Thus, trends in the composition of bovine and milch animal stock over the years indicate that the breedable cow and buffalo population is important from the point of view of milk production. The composition of bovine breeding stock has improved in terms of increased share of in-milk animals in breeding stock as well as in total adult females. The adult females among cattle account for about 38.4 per cent, while for buffalo, it was 52 per cent. The rise in numbers of buffaloes is apparently noticeable in terms of ratio of buffalo to cows in the stock of adult females, or the milch animals. The ratio of milch buffalo to milch cows increased from 0.39 in 1951 to 0.79 in 1997 and then declined to 0.74 in 2012. Thus trends in size and composition of the bovine stock in the country show that the shift is taking place in favour of the bovines as milch animals (Table 1.4).

Table 1.4: Milch Animal Population by States (2012)

State / UT's	Adult Female Bovine Population by States (2012) (In thousands)						Total Livestock	
	Crossbred Over 2 1/2 years	Indigenous Over 3 years	Total Cows	Female Buffalo >3 years	Total Cows & Buffaloes	% to all India total	(000)	% to all India
A & N Islands	8	10	18	2	20	0.02	155	0.03
Andhra Pradesh	1251	2228	3479	5763	9241	6.93	56099	10.96
Arunachal Pradesh	11	133	144	1	145	0.11	1413	0.28
Assam	175	3335	3531	157	3688	2.77	19082	3.73
Bihar	2023	3959	5982	4017	9999	7.50	32939	6.43
Chandigarh	5	1	6	10	16	0.01	24	0.00
Chhattisgarh	89	3238	3327	409	3736	2.80	15044	2.94
D & N Haveli	0	9	9	1	10	0.01	50	0.01
Daman & Diu	0	1	1	0	1	0.00	5	0.00
Goa	10	14	25	16	41	0.03	146	0.03
Gujarat	1048	3092	4141	5646	9787	7.34	27128	5.30
Haryana	522	322	844	2914	3758	2.82	8820	1.72
Himachal Pradesh	549	403	952	423	1375	1.03	4844	0.95
J& K	703	525	1228	417	1644	1.23	9201	1.80
Jharkhand	137	2486	2622	398	3020	2.27	18053	3.53
Karnataka	1829	2540	4369	2056	6425	4.82	27702	5.41
Kerala	630	36	666	10	676	0.51	2735	0.53
Lakshadweep	0	2	2	0	2	0.00	50	0.01
Madhya Pradesh	415	6538	6954	4251	11204	8.41	36333	7.10
Maharashtra	2138	3302	5440	3359	8799	6.60	32489	6.34
Manipur	20	77	96	23	119	0.09	696	0.14
Meghalaya	19	333	352	4	357	0.27	1958	0.38
Mizoram	6	10	16	2	18	0.01	312	0.06
Nagaland	52	38	90	9	99	0.07	911	0.18
NCT Of Delhi	32	15	47	95	142	0.11	360	0.07
Odisha	575	2884	3459	250	3709	2.78	20732	4.05
Pondicherry	31	1	32	1	33	0.02	120	0.02
Punjab	1182	115	1297	2805	4101	3.08	8117	1.59
Rajasthan	929	5540	6470	6933	13403	10.06	57732	11.27
Sikkim	57	5	62	0	62	0.05	292	0.06
Tamilnadu	3411	1074	4485	423	4908	3.68	22723	4.44
Tripura	54	289	343	4	347	0.26	1936	0.38
Uttar Pradesh	1828	7241	9069	15432	24501	18.38	68715	13.42
Uttarakhand	259	548	807	582	1389	1.04	4795	0.94
West Bengal	1270	5053	6323	172	6494	4.87	30348	5.93
ALL	21268	55417	76685	56586	133271	100.00	512057	100.0

Source: GOI (2016).

There are significant regional variations in total livestock and bovine population. The highest livestock population was recorded in Uttar Pradesh, followed by Rajasthan, Andhra Pradesh, Madhya Pradesh and Bihar which together accounted for one half of the total livestock in the country. In case of bovine stock, Uttar Pradesh accounted for highest share of 18.38 per cent of total bovine stock in India (2012) followed by Rajasthan, Madhya Pradesh, Bihar and Gujarat.

Livestock ownership is very widespread in rural India. Majority of marginal and small farmers own livestock. Farmers holding less than 4 ha of land constitute about more than 91 per cent of landholdings and they collectively own more than 80 per cent of the cattle and buffalo heard. The remaining 19.5 per cent of total livestock

was owned by 8.8 per cent of the landowners with average size of cattle and buffalo holding of 7.2 animals. The average number of cows buffaloes owned by each of landowner was estimated to be 2.7 animals. The dairy farms in India are not large in size as large landowners owned on an average 9.2 animals having share of 4.8 per cent of total livestock and 1.6 per cent of holdings by this group (Table 1.5).

Table 1.5: Livestock Holding Pattern among Land Owners

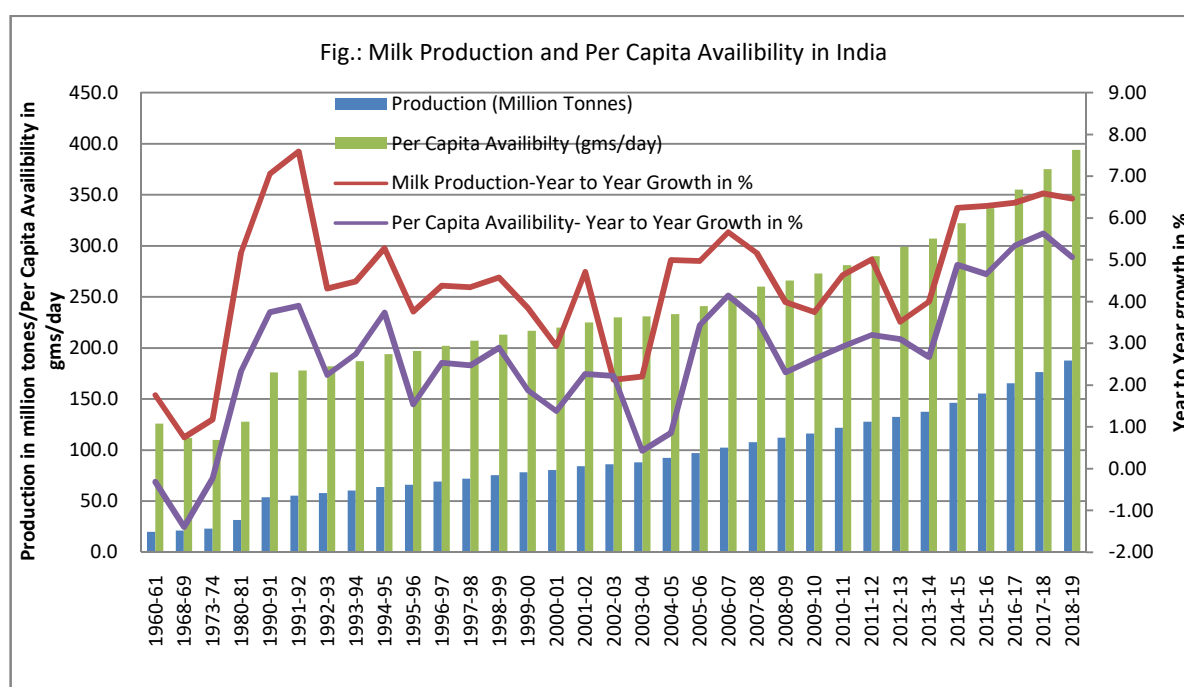
Category of Land Holdings	Distribution of Livestock (%)	Per Cent of Holding	Cattle & Buffalo per holding (Nos)
Marginal (Below 1.00 ha)	36.9	57.1	1.9
Small (1.00 to 1.99 ha)	23.5	20.3	3.6
Semi-medium (2.00 to 3.99 ha)	20.2	13.7	4.8
Medium (4.00 to 9.99 ha)	14.7	7.3	6.7
Large (10.00 ha & above)	4.8	1.6	9.2

Source: Department of Agriculture & Cooperation, Govt. of India as quoted in Chawla et.al, 2009, p.28.

1.1.3 Milk Production and Productivity in India

The dairy sector has witnessed a quantum jump in all areas, including milk production, processing and marketing during the last three decades. Milk production in India increased from 17 million tonnes in 1950-51 to 187.7 million tonnes in 2018-19 (Fig 1.1, Table 1.6). From being a recipient of massive material support from the World Food Programme and European Economic Community in the 1960s & early 1970s, India has positioned itself as the world's largest producer of milk (Sharma, 2004) and produces 19 per cent of the world's total milk production. Milk production was stagnant during the decades of 1950s and 1960s and annual production growth was negative for many years, but it improved consecutively. During last two years, compensating dairy farmers to some extent for the losses in crop sector and elsewhere due to two consecutive poor monsoon years, India continued to be the largest producer of milk in the world. Milk production has gone up from 11.2 million tonnes during 2008-09 to 146.3 million tonnes during 2014-15, and further to 187.7 million tons in 201819. It registered an annual growth rate of 6.29 and 6.59 per cent achieved during the previous two years respectively. It has achieved a significant jump in the annual growth rate over the previous years from 3.94 per cent during 2008-09 to 6.6 percent during 2017-18.

Fig.1.1: Milk Production and Per Capita Availability in India



Source: <https://www.nddb.coop/information/stats>

Table 1.6: Milk Production and Per Capita Availability in India

Year	Production		Per Capita Availability	
	Million Tonnes)	Year on Year Growth in %	gms/day	Year on Year Growth in %
1950-51	17.0	-	130	-
1960-61	20.0	1.76	126	-0.31
1968-69	21.2	0.75	112	-1.39
1973-74	23.2	1.18	110	-0.22
1980-81	31.6	5.17	128	2.34
1990-91	53.9	7.06	176	3.75
1995-96	66.2	3.76	197	1.55
2000-01	80.6	2.94	220	1.38
2005-06	97.1	4.97	241	3.43
2010-11	121.8	4.64	281	2.93
2015-16	155.5	6.29	337	4.66
2017-18	176.3	6.59	375	5.63
2018-19	187.7	6.47	394	5.07

Source: <https://www.nddb.coop/information/stats>

The regionwise contribution in total milk production is very diverse (Table 1.7) with contribution from north region at 45 per cent in total production followed by 23 per cent by West region, 20 percent by South regions and 12 per cent by East region. However, all the states are not doing well and the growth in milk production varies widely in various regions and among states within the regions. The western and central Indian states performed well in terms of growth in milk production during 2017-18, while the North-eastern and Eastern states, due to their regional peculiarities, were trying to match. Rajasthan (12.7 per cent) and Maharashtra (6.3

per cent) achieved a higher growth rate during 2017-18 among all the western regional states while Madhya Pradesh achieved significant higher growth rate (8.3 per cent) in milk production among the two central regional states of Madhya Pradesh and Chhattisgarh during 2017-18.

Table 1.7: State-wise Milk Production in India

State	Milk Production (000 tonnes)					% to all India Total 2018-19
	2001-02	2005-06	2010-11	2015-16	2018-19	
Andhra Pradesh	5814	7624	11203	10817	15044	8.01
Arunachal Pradesh	42	48	28	50	55	0.03
Assam	682	747	790	843	882	0.47
Bihar	2664	5060	6517	8288	9818	5.23
Chhattisgarh	795	839	1029	1277	1567	0.83
Goa	45	56	60	54	57	0.03
Gujarat	5862	6960	9321	12262	14493	7.72
Haryana	4978	5299	6267	8381	10726	5.71
Himachal Pradesh	756	869	1102	1283	1460	0.78
J & K	1360	1400	1609	2273	2540	1.35
Jharkhand	940	1335	1555	1812	2183	1.16
Karnataka	4797	4022	5114	6344	7901	4.21
Kerala	2718	2063	2645	2650	2548	1.36
Madhya Pradesh	5283	6283	7514	12148	15911	8.47
Maharashtra	6094	6769	8044	10153	11655	6.21
Manipur	68	77	78	79	86	0.05
Meghalaya	66	73	79	84	87	0.05
Mizoram	14	15	11	22	26	0.01
Nagaland	57	74	76	77	73	0.04
Orissa	929	1342	1671	1903	2311	1.23
Punjab	7932	8909	9423	10774	12599	6.71
Rajasthan	7758	8713	13234	18500	23668	12.61
Sikkim	37	48	43	67	61	0.03
Tamil Nadu	4988	5474	6831	7244	8362	4.45
Telangana	-	-	-	4442	5416	2.88
Tripura	90	87	104	152	185	0.10
Uttar Pradesh	14648	17356	21031	26387	30519	16.26
Uttarakhand	1066	1206	1383	1656	1792	0.95
West Bengal	3515	3891	4471	5038	5607	2.99
A&N Islands	23	20	25	15	18	0.01
Chandigarh	43	46	45	43	45	0.02
D&N Haveli	8	5	11	9	9	0.00
Daman & Diu	1	1	1	1	1	0.00
Delhi	294	310	480	281		0.00
Lakshadweep	2	2	2	3	4	0.00
Pondicherry	37	43	47	48	49	0.03
All India	84406	97066	121848	155491	187749	100.0

Source: <https://www.nddb.coop/information/stats>

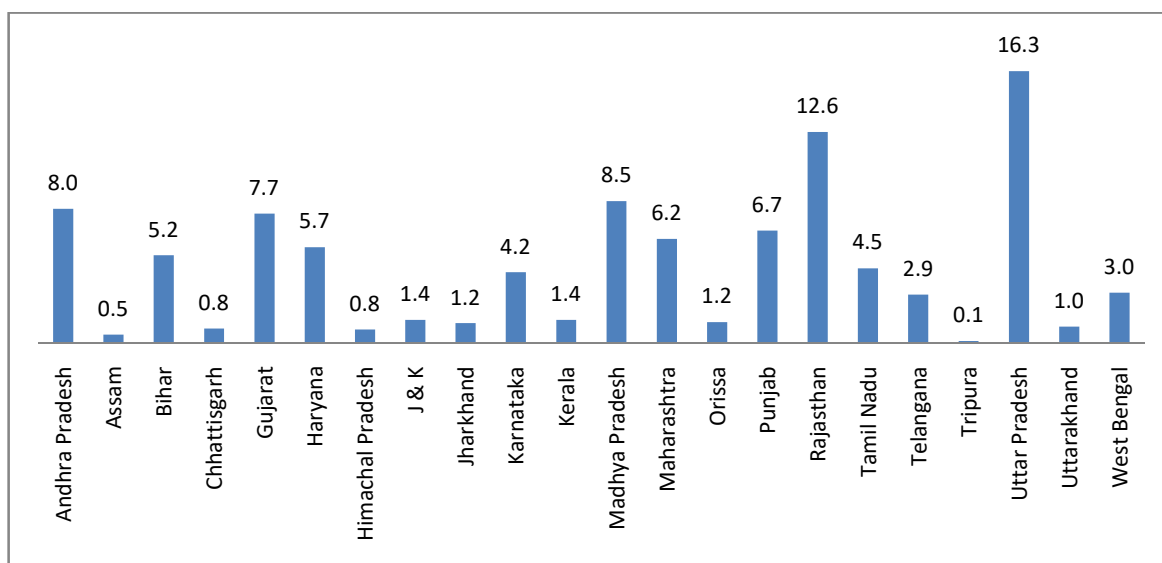
Eastern regions of the country need special attention as these states seem to be lagging behind dairying states such as Punjab, Gujarat and Karnataka (Kumar, 2016). Bihar (5.2 per cent) in the eastern region and Sikkim, Arunachal Pradesh, Tripura and Mizoram in the North Eastern region did not perform well during the mentioned years. Andhra Pradesh (8.01%) in the southern region and Jammu and Kashmir (1.4

%), Himachal Pradesh (0.8%) and Haryana (5.6%) among the northern region states achieved a higher growth rate than the national average during 2017-18.

In case of milk procurement, during the period from 2009-10 to 2017-18, the central and western Indian regions performed well in terms of milk production at 8.7 per cent and 7.58 per cent, respectively (Table 1.8, Fig. 1.2). The sector is witnessing more action from private dairies, which is likely to continue, especially in the area of milk procurement. They are now shifting their strategies to source milk directly from farmer and not through contractors. Simultaneously, they are continuing their focus on production and marketing of value added milk and milk products.

The per capita availability of the milk in the country has also increased significantly from 130 grams/day in 1950-51 to 394 gram per day in 2018-19 as against the world average of 294 grams/day during 2013. This represents sustained growth in availability of milk and milk products for the growing population of India.

Fig. 1.2: Statewise share in total Milk Production 2018-19 (%)

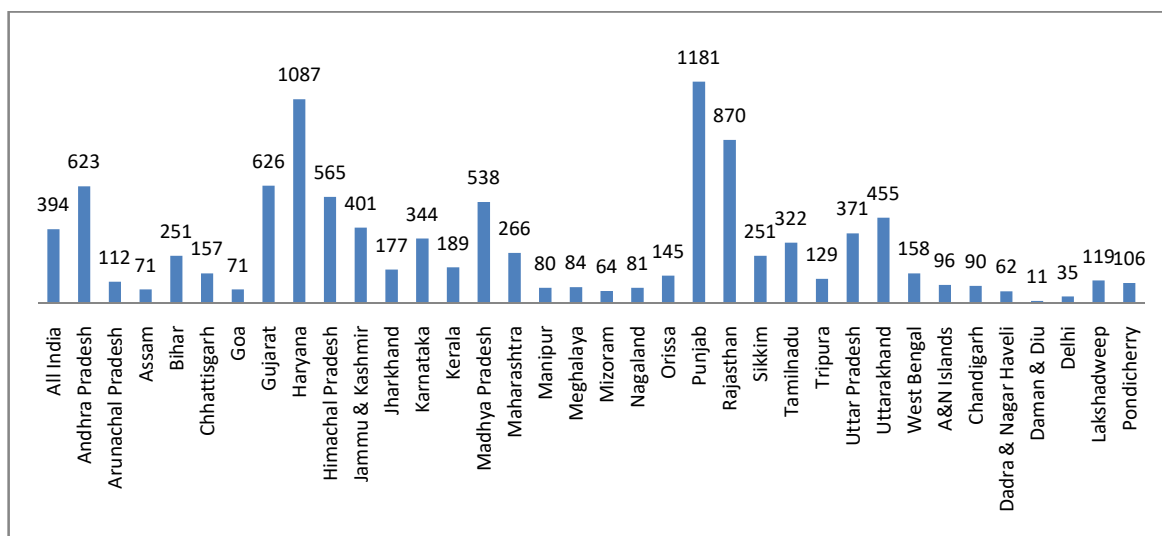


Source: <https://www.nddb.coop/information/stats>

However, there are large interregional and interstate variations in milk production as well as in per capita availability in India. The largest producer of milk amongst states was Uttar Pradesh with a production of 16.5 per cent of the total milk production in the country followed by Rajasthan (12.7 percent) and Gujarat (7.7 percent). About 70 percent of national milk production came from eight major milk producing states, viz. Uttar Pradesh, Rajasthan, Andhra Pradesh, Gujarat, Punjab, Madhya Pradesh, Maharashtra and Haryana (Fig. 1.2). However, only 12 States were

having per-capita availability more than the national average of 300 gm/day in the year 2017-18 (see, Fig. 1.3).

Fig. 1.3: State-wise Per Capita Milk Availability in India 2018-19 (gm/day)



Source: <https://www.nddb.coop/information/stats>

Table 1.8: Milk Yield in India and other Selected Countries (2012 & 2017)

Country	Milk yield in India and other selected countries- Yield (hg/animal)			
	Milk, whole fresh Cow		Milk, whole fresh Buffalo	
	2012	2017	2012	2017
India	13435	16429	17515	19974
Israel	115553	131817	NA	NA
Canada	89357	87568	NA	NA
Denmark	85067	97488	NA	NA
USA	98527	104574	NA	NA
Saudi Arabia	99750	83359	NA	NA
Republic of Korea	100954	100331	NA	NA
Pakistan	12301	12300	19349	19882
Sri Lanka	8373	11058	6545	7537
Australia	55753	57880	NA	NA
New Zealand	38183	42373	NA	NA
World average	23414	24302	16300	18098

Note: N.A. Not Available

Source: <http://www.fao.org/faostat/es/>

In spite of the importance of livestock in Indian rural economy in generating sustainable livelihood for small farmers, meeting the growing demand for milk and meat, as well as being ranked at first position in terms of cattle and buffalo population in the world, the productivity of dairy animals in India is very low as compared to other countries (Table 1.8). The milk yield no doubt has increased between 2012 and 2017 by around 22 per cent, but it is still less than 30 percent of the world average and about six times lower than milk yield in Europe. The performance of indigenous cows is observed to be poor if analysed separately from the performance of crossbred cows.

Besides, milk yield varies significantly across the states of India (Table 1.9). The reason cited for this is inappropriate feeding as well as inadequate supplies of quality feeds and fodder in addition to the low genetic profile of the Indigenous breeds. It is not possible to achieve higher productivity in milching animal by merely increasing its genetic potential. Due attention needs to be given to proper feeding of milching animals. There is no shortcut to sustain livestock husbandry, without addressing the development of fodder and feed resources.

Table 1.9: Statewise Estimates of Milk Yield Rates 2013-14 & 2017-18

Sr. No.	States/ UTs	Cows-Exotic - Average Yield/ day - (kg)		Cows-Non Descript - Av Yield/day(kg)		Buffalo - Average Yield/ day - (kg)	
		2013-14	2017-18	2013-14	2017-18	2013-14	2017-18
1	Andhra Pradesh#	7.42	9.4	2.08	3.4	4.73	7.34
2	Arunachal Pradesh	6.6	6.52	1.4	1.39	-	2.54
3	Asham	3.99	4.49	0.99	1	2.92	3.43
4	Bihar	6.11	6.56	2.94	3.34	3.95	4.38
5	Chhattisgarh	5.41	6.17	1.33	2.09	5.26	4.82
6	Goa	6.93	8.02	1.59	1.96	4.13	4.39
7	Gujarat	8.94	9.13	4.07	4.33	4.87	5.02
8	Haryana	8.37	8.65	5.22	5.69	7.54	8.74
9	Himachal Pradesh	4.68	4.92	1.68	1.93	3.6	3.78
10	Jammu & Kashmir	5.65	7.8	2.62	3.63	4.83	5.16
11	Jharkhand	5.99	7.28	1.69	1.57	5.88	3.34
12	Karnataka	6.11	6.03	2.35	2.26	2.7	3
13	Kerala	8.55	10.19	0.59	2.99	3.28	4.98
14	Madhya Pradesh	7.38	8.42	2.52	2.84	3.98	4.46
15	Maharashtra	7.18	9.18	1.76	2.28	4.35	5.07
16	Manipur	7.31	7.32	1.46	1.47	3.3	3.32
17	Meghalaya	8.96	8.95	0.76	0.77	1.83	1.84
18	Mizoram	6.53	7.67	1.59	1.59	-	0
19	Nagaland	5.4	5.34	1.84	1.79	3.67	3.19
20	Odisha	6.18	6.3	1.63	1.37	3.87	3.94
21	Punjab	11.04	12.44	6.59	6.75	8.72	8.3
22	Rajasthan	7.75	8.26	3.68	4.89	5.76	6.61
23	Sikkim	5.74	5.03	1.78	0.6	4.66	0
24	Tamil Nadu	6.87	6.89	2.71	2.92	4.42	3.87
25	Telangana	-	7.61	-	2.38	-	5.07
26	Tripura	5.4	5.71	1.32	1.76	2.48	2.58
27	Uttar Pradesh	7.09	7.24	2.59	3.02	4.45	4.49
28	Uttarakhand	6.88	7.18	1.95	2.16	4.18	4.61
29	West Bengal	3.58	6.15	2.65	3.07	5.42	5.11
30	A & N Islands	4.54	5.72	2.95	3.24	3.4	3.64
31	Chandigarh	9.03	11.61	3	5.33	6.2	8.77
32	D. & N. Haveli	9.28	-	3.75	-	4.65	-
33	Daman & Diu	8.65	6.46	-	3.99	2.64	4.69
34	Delhi	5.91	-	3.97	-	5.8	-
35	Lakshadweep	5	5	3	3	-	0
36	Puducherry	5.83	5.89	2.56	2.58	5.59	5.47
	All India	6.78	7.71	2.5	2.93	4.91	5.47

Notes:#includes Telangana till 2013-14; "-" not available/not received;The yield rate for 2015-16 onwards is calculate based on the separate yield rate of exotic & CB.
Source: GOI (2018 , Basic Animal Husbandry Statistics 2018).

The average milk yield of indigenous breeds of cattle has been around 2.93 litres as compared to 7.71 liters for crossbreds and 5.47 liters for buffaloes. As noted by Hegde³ (2006, p2), yield of indigenous cattle may not include the yield of draft breeds and non-descript cows which are hardly milked due to low yields. Thus, except 15-20 per cent of crossbreds and elite native breeds, about 80-85 per cent of the livestock, particularly the cattle are not contributing to the milk production. However, they compete for fodder and feed, resulting in huge shortage of feed resources. It is because of the large number of unproductive animals that there has been severe shortage of feed and fodder resources. Thus, feed scarcity is the main factor limiting the improvement of livestock productivity. For example, the actual milk yield of bovines is reported to be 26 to 51 per cent below the attainable yield under field conditions (Birthal and Jha, 2005).

1.1.4 Status of Availability of Feed and Fodder in India

Shortage of fodder and feed has been a major constraint in the development of the livestock economy of India (Seetharaman, et al., 1997). Feed accounts for 65-70 per cent of the total cost of production and maintenance of the animals. There is a direct relation between the nutritional status of the animals and the type of feed fed. One of the prominent characteristics of Indian livestock is that almost its entire feed requirement is met from crop residues and by-products like grasses, weeds, tree leaves gathered from cultivated and uncultivated lands, grazing on common lands and harvested fields. For improving the yield of milching animals, feeding of animal needs planned, scientific, practical as well as economic approach. Livestock feeds are generally classified as roughages and concentrates. Roughages are further classified into green fodder and dry fodder. Green fodder is cultivated and harvested for feeding the animals in the form of forage (cut green and fed fresh), silage (preserved under anaerobic condition) and hay (dehydrated green fodder). The cereals crops residues contribute about 71 per cent of overall feed resources used for animals feeding, green fodder accounts for 23 percent and concentrated feeds account for 6 per cent (GOI, 2017).

³ http://www.baif.org.in/doc/Livestock_Devt/Livestock%20Devt%20for%20Sustainable%20Livelihood%20of%20Small%20Farmers.doc

Table 1.10: Area under Fodder Cultivation and Permanent Pastures & Other Grazing Lands in India

States/UTs	Fodder Crops (2014-15)*		Permanent Pastures & Other Grazing Land 14-15	
	(000 ha)	% to GCA	(000 ha)	% to GCA
Andaman and Nicobar Islands	0	0.00	4	0.00
Andhra Pradesh	64	0.07	214	0.22
Arunachal Pradesh	0	0.00	18	0.02
Assam	4	0.00	167	0.17
Bihar	20	0.02	15	0.02
Chandigarh	0	0.00	0	0.00
Chhattisgarh	0	0.00	887	0.92
Dadra and Nagar Haveli	0	0.00	1	0.00
Daman and Diu	0	0.00	0	0.00
Delhi	1	0.00	0	0.00
Goa	0	0.00	1	0.00
Gujarat	850	0.88	851	0.88
Haryana	420	0.44	25	0.03
Himachal Pradesh	9	0.01	1510	1.57
Jammu and Kashmir	53	0.05	112	0.12
Jharkhand	0	0.00	114	0.12
Karnataka	28	0.03	904	0.94
Kerala	6	0.01	0	0.00
Lakshadweep	0	0.00	0	0.00
Madhya Pradesh	367	0.38	1303	1.35
Maharashtra	969	1.00	1249	1.29
Manipur	0	0.00	1	0.00
Meghalaya	0	0.00	0	0.00
Mizoram	0	0.00	11	0.01
Nagaland	0	0.00	0	0.00
Odisha	0	0.00	524	0.54
Pondicherry	0	0.00	0	0.00
Punjab	498	0.52	5	0.01
Rajasthan	4928	5.11	1674	1.74
Sikkim	0	0.00	0	0.00
Tamil Nadu	91	0.09	108	0.11
Telangana	27	0.03	299	0.31
Tripura	0	0.00	1	0.00
Uttar Pradesh	767	0.80	65	0.07
Uttarakhand	32	0.03	192	0.20
West Bengal	3	0.00	2	0.00
India	9137	9.47	10258	10.63

Source: www.indiastat.com

The major sources of fodder supply are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands. The total area under cultivated fodders was 9.13 million hectares in 2014-15, which accounted for barely 4.6 per cent of gross cropped area (Table 1.10), while area under permanent pastures and other grazing land was 10.26 mha in 2014-15 (which accounted for barely 5.2 per cent of gross cropped area). The share of permanent pastures and other grazing land in gross cropped area declined from 4.68 per cent in 1960-61 to 3.33 per cent in 2014-15 (GOI, 2018). The pasture lands available in the different states are overgrazed and not properly managed which lead to lower

productivity. In different states, grazing pressure on this land is very high compared to carrying capacity. About 70 per cent of grazing land comes under poor to very poor condition in Rajasthan having productivity below 500 kg/ha (GOI, 2017). The details about forage crops grown in India are presented in Table 1.11. Sorghum amongst the kharif crops (2.6 million ha) and berseem amongst the rabi crops (1.9 mha) occupy about 54 per cent of the total cultivated fodder cropped area.

Table 1.11: Forage Crops grown and their Area and Productivity in India

Sr. No.	Crop	Botanical name	Area (000 ha)	Green fodder yield (t/ha)
1	Berseem (Egyptian clover)	Trifolium alexandrinum	1900	60-110
2	Lucerne (Alfalfa)	Medicago sativa	1000	60-130
3	Senji (Sweet clover)	Melilotus indica	5	20-30
4	Shaftal (Persian clover)	Trifolium resupinatum	5	50-75
5	Metha (Fenugreek)	Trigonella foenum-graecum	5	20-35
6	Lobia (Cowpea)	Vigna unguiculata	300	25-45
7	Guar (Clusterbean)	Cyamopsis tetragonaloba	200	15-30
8	Rice bean	Vigna umbellata	20	15-30
9	Jai (Oat)	Avena sativa	100	35-50
10	Jau (Barley)	Hordeum vulgare	10	25-40
11	Jowar/Chari (Sorghum)	Sorghum bicolor	2600	35-70
12	Bajra (Pearl millet)	Pennisetum glaucum	900	20-35
13	Makka (Maize)	Zea mays	900	30-55
14	Makchari (Teosinte)	Zea mexicana	10	30-50
15	Chara sarson (Chinesecabbage)	Brassica pekinensis	10	15-35

Sources: NITI Ayog (2018, p.59), <http://agropedia.iitk.ac.in/content/area-under-fodder-production-india>;

The estimates suggest that there is a wide variation in the fodder production in the country. Fodder production and its utilization depend on various factors like cropping pattern followed, climatic condition of the area as well as the socio-economic conditions of the household and type of livestock reared. The cattle and buffaloes are normally fed on the fodder available from cultivated areas, supplemented to a small extent by harvested grasses. Thus, major sources of fodder for feeding the livestock in India are crop residues (54%), fodder from grasslands (18%) and cultivated fodder crops (28%) (Hegde, 2006). 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 as 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 Bangalore, dairy animal owners purchased chaffed sorghum stalk at a price of Rs. 5500 to Rs. 6500 per ton. Even wheat straw was sold in the range of Rs. 2000 to Rs. 3 per ton, while paddy straw was sold at Rs.1500 to Rs. 2000 per ton. 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 manufacturing of paper and particle boards as well as for generation of electricity. Generally, crop residues such as fodder fetch better price than as an 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 agriculturally rich areas, while certain other regions are facing fodder shortage. Approximate cost of one kg of cattle feed is Rs. 17/- with average dry matter content of 90 per cent, crude protein (CP) 20 per cent and total digestible nutrients (TDN) is 70 per cent, while same for one kg of legume green fodder is Rs. 2/- with average dry matter, CP and TDN content of 20, 18 and 65 per cent respectively (Garg, 2018). Thus availability of nutrients from green fodder is significantly cheaper than what is available in concentrate feed. 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.

Availability of feed and fodder is a major constraint in promotion of dairy husbandry in India. A well balanced animal nutrition consist of green fodder, dry fodder, concentrates (Malik and Garg, 2013). India's livestock population was 512 million in 2012 and was expected to grow at the rate of 0.55 per cent in the consecutive years (IGFRI, 2013) (Table 1.12). Estimate of fodder requirement and availability by several committees vary considerably for two reasons: i) use of different estimates of livestock population and different feeding schedule for different classes of livestock, and ii) fodder requirements estimates considered only for cattle and buffaloes. However, there is a huge shortage of feed and fodder resources and the shortages are likely to worsen in the coming decades. It has been estimated that only 880 million tons of dry fodder was available including greens, which is only sufficient to address 35-40 per cent of the demand. This clearly indicates that as most of the livestock are unfed, they are not able to generate yield optimally. Out of the available dry matter, most of it is available in the form of agricultural by-products and dried grass collected from community wastelands and forests which are of inferior quality. Similarly, the concentrates required for feeding the livestock are also in acute shortage. As a result, even the high yielding animals, which are presumably well-fed suffer from nutritional imbalance.

In India, an estimated 50 million tonnes of ‘concentrates feed ingredients’ are available annually which yield about 10 million tonnes of Crude Protein (CP) and 32.5 million tonnes of Total Digestible Nutrients (TDN). In comparison, the annual production of green fodder is estimated at nearly 500 million tones, with a yield of around 12 million tonnes of CP and 55 million tonnes of TDN. Thus, green fodder is a vital source of nutrients, especially vitamins, for livestock. Green fodder is primarily obtained through cultivation. Despite of large area under cultivation of fodder (9.137 mha), green fodder is scarce due to low yield levels, with an average annual yield of meagre 40 tonnes/hectare, which is low. In view of land constraints, efforts need to be put forth to enhance fodder production from available land and to increase availability of fodder by minimising wastage.

Table 1.12: Projected Livestock Population Estimates

Year	Projected Livestock Population Estimates* (million adults cattle unit, ACU [#])						
	Cattle	Buffalo	Sheep	Goat	Equine	Camel	Total
2010	127.3	88.8	4.6	9.03	0.75	0.49	231.1
2020	129.1	95.3	5.03	10.32	0.63	0.43	240.8
2030	133.6	106.8	5.39	11.18	0.54	0.29	257.9
2040	136.6	115.0	5.76	11.99	0.40	0.20	270.1
2050	139.6	127.1	6.13	13.19	0.29	0.12	286.5

Notes: *estimates based on past livestock censuses published by the Directorate of Economics and Statistics and Department of Animal Husbandry and Dairying; [#] Category-wise population was multiplied with standard body weight to get total weight with conversion to ACU (1 ACU=350kg)

Sources: NITI, Ayog (2018), IGFRI (2013, Vision 2050).

Several studies have indicated deficit of fodder and feed resources in the country. At present, there is huge gap between demand and supply of animal feed and fodder (see, Tables 1.13 to 1.17). The 34th report of Parliamentary Standing Committee on Agriculture has also indicated shortage of 122 million tonnes dry fodder, 284 million tonnes of green fodder and 35 million tonnes of concentrate by 2024 (GOI, 2017). At present there is no feed and fodder security for more than 500 million animals in the country. The increased growth of livestock particularly that of genetically upgraded animals has further aggravated the situation. Additionally, the quality of the available fodder is also poor, being deficient in energy, protein and minerals. The pattern of deficit varies in different parts of the country (NITI Ayog, 2018). For instance, the green fodder availability in Western Himalayan, Upper Gangetic Plains, Eastern Plateau and Hilly Zones is more than 60 per cent of the actual requirement. In Trans-Gangetic Plains, the feed availability is between 40 and 60 per cent of the requirement and in the remaining zones, the figure is below 40 per

cent. In case of dry fodder, availability is over 60 per cent in the Eastern Himalayan, Middle Gangetic Plains, Upper Gangetic Plains, East Coast Plains and Hilly Zones. In Trans Gangetic Plains, Eastern Plateau and Hills and Central Plateau and Hills, the availability is in the range of 40-60 per cent, while in the remaining zones of the country the availability is below 40 per cent. The regional deficits are more important than the national deficit, especially for fodder, since it is not economical to transport over long distances (Satyanarayan, et al. 2017).

Table 1.13: Estimates of Feed and Fodder in India

Year	Estimates of feed and Fodder in India (<i>million tonnes</i>)								
	Dry			Greens			Concentrates		
	Available	Required	Deficit (%)	Available	Required	Deficit (%)	Available	Required	Deficit (%)
2015	387	491	21	619	840	26	58	87	34
2020	408	530	23	596	880	32	61	96	36
2025	433	550	21	600	1000	40	65	105	38

Source: NITI Ayog (2018); Gotri, et al, 2012 (NIANP, Bangalore), as quoted in Garg (2018).

Table 1.14: Supply and Demand of Green and Dry Fodder

Year	Supply (<i>million tonnes</i>)		Demand (<i>million tonnes</i>)		Deficits (<i>million tonnes</i>)		Deficits as a % of demand (<i>million tonnes</i>)	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry
2010	525.51	453.28	816.83	508.99	291.32	55.72	35.66	10.95
2020	590.42	467.65	851.34	530.50	260.92	62.85	30.65	11.85
2030	687.46	500.03	911.67	568.10	224.21	68.07	24.59	11.98
2040	761.76	524.40	954.81	594.97	193.05	70.57	20.22	11.86
2050	826.05	547.78	1012.70	631.05	186.05	83.27	18.43	13.20

Note: Figures in Parentheses indicates actual deficit; quantities in million tonnes

Source: Indian Grassland and Fodder Research Institute (2013) and GOI (2017)

Table 1.15: Availability, Requirement & Deficit of CP & TDN including CP & TDN from concentrates

Year	Crude Protein CP and Total Digestible Nutrients TDN (<i>Figures in million tonnes</i>)					
	Requirement		Availability		Deficit (%)	
	CP	TDN	CP	TDN	CP	TDN
2000	44.49	321.29	30.81	242.42	30.75	24.55
2005	46.12	333.11	32.62	253.63	29.27	23.86
2010	47.76	344.93	34.18	262.02	28.44	24.04
2015	49.39	356.73	35.98	273.24	27.15	23.41
2020	51.04	368.61	37.50	281.23	26.52	23.70
2025	52.68	380.49	39.31	292.45	25.38	23.14

Table 1.16: Availability, Requirements and Deficit of Concentrates for Livestock

Particulars	Availability, requirements and deficit of concentrates for livestock (<i>million tonnes</i>)				
	2002-03	2003-04	2004-05	2005-06	2006-07
Available	41.96	43.14	44.35	45.63	48.27
Required	117.44	120.52	123.59	127.09	130.55
Deficit (%)	64.27	64.21	64.12	64.10	63.03

Source: www.indiastat.com

Table 1.17: State-wise Production of Dry and Green Fodder('000 tonnes)

States/Union Territories	2000-01			2001-02			2002-03		
	Dry fodder	Green fodder	Total fodder	Dry fodder	Green fodder	Total fodder	Dry fodder	Green fodder	Total fodder
Andhra Pradesh	36759	14573	51333	33473	14405	47877	26053	14240	40293
Arunachal Pradesh	471	7731	8202	478	7731	8209	518	7731	8249
Assam	6146	3372	9518	5962	3372	9334	5745	3372	9117
Bihar	19523	1377	20901	19158	1361	20520	15612	1346	16957
Chhattisgarh	4710	21192	25903	8942	20957	29899	5189	20730	25919
Goa	251	189	440	223	189	412	233	189	421
Gujarat	12444	56158	68602	21515	56895	78411	15250	57643	72894
Haryana	19701	19400	39102	21136	19204	40340	18855	19011	37866
Himachal Pradesh	2573	3137	5710	3237	3183	6419	2187	3230	5417
Jammu & Kashmir	2365	6083	8448	2635	6113	8747	2510	6142	8652
Jharkhand	2863	3713	6577	3430	3708	7137	3839	3702	7542
Karnataka	41990	7409	49399	32759	7299	40058	28368	7195	35563
Kerala	1086	1738	2824	1026	1745	2771	1014	1752	2766
Madhya Pradesh	29287	34921	64208	37672	34059	71732	27223	33227	60450
Maharashtra	43915	80013	123928	44193	88363	132556	42390	97682	140073
Manipr	547	903	1450	549	903	1452	539	903	1442
Meghalaya	333	1400	1733	347	1400	1746	343	1399	1742
Mizoram	200	2615	2815	207	2692	2899	208	2771	2979
Nagaland	649	1311	1960	726	1314	2039	903	1316	2219
Orissa	7280	8856	16136	10564	8868	19432	5267	8881	14148
Punjab	31182	26704	57886	30983	26102	57085	29350	25513	54863
Rajasthan	24056	116890	140946	37460	117093	154553	16540	117297	133836
Sikkim	274	437	711	259	437	696	267	437	704
Tamil Nadu	25066	10549	35615	23300	10525	33824	21429	10500	31929
Tripura	705	909	1614	803	909	1712	751	909	1660
Uttar Pradesh	87014	37065	124079	91433	36438	127871	80798	35823	116621
Uttarakhand	4807	17495	22302	4747	17289	22036	4366	17087	21453
West Bengal	19806	1889	21695	23173	1887	25060	21646	1885	23530
A & Nicobar Island	45	1047	1092	37	1048	1085	40	1048	1088
Chandigarh	0	83	83	0	83	83	0	83	83
Dadra & Nagar Haveli	9	63	72	10	58	68	10	54	64
Daman & Diu	48	0	48	64	0	64	47	0	47
Delhi	132	35	167	157	33	190	113	31	144
Lakshadweep	0	0	0	0	0	0	0	0	0
Pondicherry	80	0	80	106	0	106	85	0	85
All-India	426318	489259	915577	460764	495659	956424	377688	503129	880818

Note:1. Green fodder production is estimated assuming an average yield per hectare of 1.5 tonnes from the forest area, 0.75 tonnes from permanent pastures and grazing lands and 40 tonnes from cultivated areas.

2. For dry fodder, production of various crops are projected using growth trends and crop residue production is estimated using standard conversion ratio for cereals, pulses and oilseeds.

3. Total fodder is the sum of dry and green fodder production. Total may not tally due to rounding off.

4. Area under forests, fodder crops and permanent pastures etc. for these years has been projected based on past data.

Source: http://www.iasri.res.in/agridata/08data/chapter1/db2008tb1_40.pdf (GOI, (2004) Basic Animal Husbandry Statistics, 2004, Dept of Animal Husbandry & Dairying, Ministry of Agriculture, GOI.)

Shortage of fodder is chronic in those areas where farming is dependent on rainfall or in areas having irrigation but large livestock population (Table 1.18). This is the case in Rajasthan, Gujarat, Maharashtra, Karnataka and certain parts of Andhra Pradesh where scarcities and droughts are more often. Availability of fodder is

generally satisfactory during the monsoon season in all regions including areas of chronic fodder shortage, provided the rainfall is normal. August to October is considered flush season for fodder. Very acute shortage of fodder is felt from March to June, the period before the onset of monsoon season. If the monsoon fails, fodder availability becomes difficult from October. Since not all areas are self sufficient in fodder/grasses, there is movement of fodder/grasses from surplus area to deficit area. Even within an area, fodder/grasses are surplus with some farmers while some other have to purchase it to meet the deficit. Thus inter area production and intra area sale and purchase of fodder/grasses regularly take place. Such movement get impetus during periods of drought in some areas (Seetharaman, et al., 1997).

Table 1.18: State-wise Availability and Requirement of Fodder in India (2008)

(Dry Matter in Million Tonnes)

States/UTs	Availability		Requirement	
	Crop Residues	Greens	Crop Residues	Greens
Andhra Pradesh	15.69	4.88	31.71	16.91
Arunachal Pradesh	0.47	1.57	1.00	0.53
Assam	5.82	0.95	12.39	6.61
Bihar	16.23	0.81	23.49	12.53
Chhattisgarh	9.93	2.83	14.93	7.96
Goa	0.13	0.05	0.15	0.08
Gujarat	10.61	14.48	22.32	11.9
Haryana	8.75	6.57	9.95	5.31
Himachal Pradesh	2.30	1.98	4.60	2.45
Jammu and Kashmir	2.53	0.64	6.79	3.62
Jharkhand	4.10	0.88	13.59	7.25
Karnataka	14.59	3.55	20.66	11.02
Kerala	0.71	0.39	2.91	1.55
Madhya Pradesh	24.3	11.65	37.41	19.95
Maharashtra	22.21	25.12	33.68	17.96
Manipur	0.36	0.00	0.72	0.38
Meghalaya	0.31	0.40	1.17	0.62
Mizoram	0.15	0.50	0.06	0.03
Nagaland	0.56	0.30	0.74	0.40
Orissa	12.25	2.46	22.27	11.88
Punjab	13.71	7.38	10.58	5.64
Rajasthan	21.67	33.53	33.53	17.88
Sikkim	0.23	0.01	0.25	0.13
Tamil Nadu	7.01	3.70	16.46	8.78
Tripura	0.53	0.19	1.09	0.58
Uttar Pradesh	42.07	15.73	57.19	30.5
Uttarakhand	2.05	1.73	4.9	2.61
West Bengal	13.77	0.51	30.3	16.16
A & N Islands	0.02	0.00	0.11	0.06
Chandigarh	0.00	0.00	0.04	0.02
Dadra & Nagar Haveli	0.04	0.20	0.80	0.40
Daman and Diu	0.01	0.00	0.10	0.00
Delhi	0.09	0.10	0.43	0.23
Lakshadweep	0.00	0.00	0.10	0.00
Pondicherry	0.06	0.01	0.11	0.06
India	253.26	142.82	415.83	221.63

Source: <https://www.indiastat.com>

In animal feed supply, coarse cereals have a major role and these account for about 17 per cent of the total cereals production (Table 1.19). In fact traditionally crop and livestock sectors are interrelated to each other. The interactions between these two sectors are so complex that it would be difficult to estimate the contribution of one in another's progress. Availability of concentrates and crop residues are directly linked with agricultural production. However, agricultural production in India for last five decades has grown at around 2.2 per cent only. Availability of crop residues is further declining due to adoption of high yielding dwarf varieties/hybrids and field wastage due to extensive use of grain picker/mechanical harvester in cereal crops (Garg, 2018). The crop sector mainly supplies fodder to livestock, while livestock provides manure and resilience against drought to crop sector. Production of cereals was around 47 million tonnes. Maize accounted for around 60 per cent of the total coarse cereals produced in the India. Most of the coarse cereals in the developed countries are mainly used for cattle feed and some of the cereals like barley are used in breweries. However, in India their use is mainly for direct consumption mostly by poor in the villages.

Table 1.19: Production of Coarse Cereals in India

Crops	Production of Coarse Cereals in India (<i>Figures in million tonnes</i>)								
	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2015-16	2018-19
Coarse Cereals	15.4	23.7	30.6	29.0	32.7	31.1	43.4	38.4	42.6
Total Cereals	219.9	203.5	226.3	242.2	236.9	185.7	226.3	235.8	257.4
Coarse cereals % to total cereals	7.0	11.7	13.5	12.0	13.8	16.7	19.2	16.3	16.6
Maize % to total coarse cereals	0.8	2.0	3.3	2.9	3.8	6.5	9.6	8.9	10.8

Sources: GOI (2018) & <http://pib.nic.in>

Compound feed plays an important role in improvement in milk yields of cattle and buffalo by offering balanced diet. Driven by the strong growth in dairy industry, compound feed volumes have increased at an average rate of 6 per cent during the period from 2007-08 to 2012-13. Based on the number of productive dairy animals and the current requirement (0.5 kg), the current estimated compound feed requirement is 65-70 million tonnes, while current production is sufficient to feed only about 7 per cent of the total breedable animals in India. Current consumption volumes are approximately 7.5 million tonnes. The actual market is much smaller because a large portion of this market is serviced by the unorganized (grazing) sector. The three key types of cattle-feed producers are (a) Home-mixers, (b) Dairy

cooperatives; and (c) Private sector manufacturers of compound cattle feed. There would still be a significant gap between market potential and supply. Many cooperatives have also set up their own modern computerized feed plants. They have modern milk processing plants in which they produce and market pasteurized milk, butter, butter oil, chocolate, and other value added products. The feed production in cooperatives was about 2.5 million tonnes per year (Table 1.20).

Table 1.20: Region-wise Cattle Feed Production in India

Region	States	Private Sector (million MT/year)	Cooperative Sector (million MT/year)	Total (million MT/year)	% Share
Western	Gujarat, Maharashtra, Goa, Madhya Pradesh	1.80	1.70	3.50	48%
Northern	Punjab, Haryana, UP, Uttarakhand, Rajasthan	0.80	0.42	1.22	17%
Southern	Karnataka, AP, TN, Kerala, Pondicherry	1.20	1.11	2.31	31%
Eastern	Bihar, Jharkhand, Odisha, WB, Assam	0.20	0.10	0.30	4%

Source: FASR (2015), Yes Bank (https://www.yesbank.in/.../indian_feed_industry-_revitalizing_nutritional_security.pdf)

Deficit of feed and fodder resources results into exorbitant increase in the prices of concentrates and crop residues in many parts of the country. Higher cost of feed and fodder makes dairy farming a challenging enterprise for landless, marginal and small dairy farmers and their livelihood is at stake in rural areas. Due to deficiency of green fodder, farmers are feeding little quantity of green fodder to livestock affecting their health, breeding and milk yield. RBP data of few productive animals indicate that average dry matter intake from green fodder in indigenous cattle, buffalo and cross breed animals was in the range of 23-27 per cent while in the developed countries it is about 60 per cent including conserved fodder (silage and hay) (Garg, 2018). Therefore, to meet growing nutrient requirement of dairy animals in an economic way, there is urgent need to focus on green fodder production enhancement programme.

Fodder Seed Production:

One of the stumbling blocks for lower fodder yield and availability is lack of sufficient quantity of quality seed of high yielding improved varieties/hybrid. At present seed replacement rate in fodder crops is less than 20 per cent⁴. Higher seed replacement rate is directly correlated with higher yield. The fodder crops are represented by several cereals, legumes and grasses. Out of these, few crops are under

⁴ Ministry has kept SRR rate for self pollinated crops at 33 per cent, 50 per cent for cross pollinated crops and 100 per cent for hybrids for all crops.

proper seed chain. Only few public sector agencies like Indian Grassland and Fodder Research Institute (IGFRI) and State Agricultural Universities (SAUs) are producing gross seeds that too under TL category. The seed requirement for the probable fodder crop area in the country estimated by taking into consideration seed multiplication through standard seed chain shows that the breeder seed is not being produced as per the requirement (Table 1.21).

Table 1.21: Estimated National Seed Requirement & Status of Breeder Seed Produced

Crops	Area (mha)	Av. Seed Rate (kg/ha)	Estimated seed requirement			Breeder seed produced (T) during 2012-13
			Certified Seed (T)	Foundation seed (T)	Breeder Seed (T)	
Maize	0.9	20	18000	180	1.8	18.160
Sorghum	2.6	10	26000	260	2.6	2.976
Bajra	0.9	10	9000	112	1.4	0.575
Oat	0.25	75	18700	937.5	46.9	53.960
Berseem	2	20	40000	1600	64.0	7.725
Lucerne	1	15	15000	562.5	21.6	0.104
Cowpea	0.3	20	6000	200	6.7	0.370
Guar	0.2	20	4000	89	2.0	37.220
Total			136700	3941	147.0	121.090

Source: Vijay, et al., 2014 (IGFRI).

The seed production for fodder crops face basic production problems of low Seed Multiplication Ratio (SMR) as the cultivated fodder varieties are not developed for seed. The Regional Fodder Stations of Department of Animal Husbandry and Dairying (DADF, GOI) reasonably produces foundation seeds of desired variety. It then supplies to States that fulfil their foundation seed needs for further multiplication and distribution as certified/quality seeds in the form of minikits. The seed production is around 500-600 tons annually in the form of foundation seed and TL seeds. Thus, there is significant gap in availability and requirement of quality fodder seed. As per IGFRI (2013), from the existing scenario it can be inferred that, (a) the actual breeder seed requirement is not being intended for seed production; (b) the produced breeder seed is not being multiplied following seed chain, which is most common problem even with food crops, and (c) the actual area under fodder crops needs authenticated data by including them under agricultural statistics data collection.

Therefore 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 in Table 1.22. As suggested by Standing Committee on Agriculture (GOI, 2016), high yielding fodder varieties mentioned in Table 1.23 may be considered for seed production programme for

improving fodder yield per hectare with regards to existing area under fodder: Forage crops and their varieties suitable for waterlogged soil is presented in table 1.24.

Table 1.22: Details regarding Dual purpose Fodder species Cultivated in different regions

Sr. No.	Type of land	Rainfed	Irrigated
1	Arid Tracts	Jowar, Bajra, Moth, Guar, Lobia	Lucerne, Berseem, Oats, Maize, Jowar, Bajra, Barley
2	Semi-dry Tracts	Jowar, Bajra, Moth, Guar, Lobia, Velvet Bean, Field Bean, Guinea grass, <i>Setaria sphacelata</i> , Rhodes grass	Jowar, Maize, Lobia, Teosinte, Lucerne, Berseem, Sarson, Turnips, Hybrid Napier, Oats, Sudan grass, Guinea grass
3	Semi-wet Tracts	Dinanath grass, Jowar, Lobia, Rice Bean, Velvet Bean, Teosinte, Sun hemp	Berseem, Oats, Sudan grass, Hybrid Napier, Guar, Jowar, Maize, Para grass, Rhodes, Setaria
4	Wet regions	Jowar, Dinanath, Rice Bean, Coix	Berseem, Oats, Hybrid Napier, Guinea, Lucerne, Sarson, Turnips, Oats, Setaria, Para grass, Jowar
5	Lower Hills	Jowar, Lobia, Bajra, Velvet Bean, Field Bean, Guar	Maize, Jowar, Oats, Berseem, Lucerne, Hybrid Napier, Sudan grass, Setaria, Rhodes

Source: GOI (2016) Standing Committee.

Table 1.23: High yielding Fodder Varieties suggested for Seed Production Programme

Sr. 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, C-23, Yashwant, NB-21, PNB-84, NB-21
4	Bajra	Giant bajra, L-74, GFB-1, Raj. Bajra chari-2, HC 20, AVKB-19
5	Cowpea	BL-1, BL-2, UPC-622, UPC-5286, UPC-4200, EC-4216, NP-3
6	Guar	BG-1, BG-2, BG-3, Bundel-2, HG 365, HG563, RG-1003
7	Berseem	Wardan, Bundel berseem-2, BL-1, BL-10
8	Oats	JHO-851, JHO-822, UPO-212, Kent, OS-6
9	Chinese cabbage	-

Source: GOI (2016)

Table 1.24: Forage Crops and their Varieties suitable for Waterlogged Soil

Soil condition	Suitable crop
Standing water	Almon grass (<i>Echinochloa polyptrachya</i>), Para grass, Coix sps., <i>Iseilema laxum</i> , <i>Chloris gayana</i> , signal grass, karnal grass, congosignal grass
Shallow water table	Teosinte (<i>Zea Mexicana</i>), shevary (<i>Sesbania sesban</i>)
Temporary water logged soil drained in rabi season	Sasuna (<i>Medicago denticulate</i>), teera (<i>Lathyrus sativus</i>), chatarimatri (<i>Vicia sativa</i>), oats and Berseem
Riverine flood water logging	Sorghum (PC-6), Teosinte (TL-6)
Saline water logged	Casuarinas and Populus

Source: GOI (2016)

The reasons for deficit of fodder is absence/lack of reliable data on cropwise area under different fodder crops due to which it is difficult to estimate the seed requirement. Besides, due to lack of priority of fodder development, lack of dedicated trained manpower in the District Animal Husbandry Department of State, and lack of

long term vision to focus on this activity by Milk Unions, result into scarcity of fodder and fodder seed. Also fodder seed production is highly unorganised. Large public sector seed companies are focusing on production of food crop seeds, while organised private sector seed companies are focusing on high value low volume crops like vegetables, hybrids and Genetic Modified crops. Few organised private companies are involved in production of sorghum sudan grass hybrid fodder seed only. Considering that dairy farmers primarily suffer with deficit of certified fodder seeds of high yielding improved varieties/hybrids, NDDB initiated fodder seed production and marketing programme in Operation Flood II through dairy cooperatives. NDDB has supported 15 dairy cooperatives for production of around 4000 tones of fodder seeds annually.

1.1.5 Fodder Development Programmes

Fodder is an important component of animal ration and its adequate availability is essential to exploit the genetic potential of the livestock⁵. Despite of the fact that green fodder is an economic source of micro and macro nutrients; its availability is a limiting factor for the growth of dairy industry. The availability of green and dry fodder is constrained due to the fact that most of the milk producers are landless, marginal and small farmers and do not have sufficient land for fodder production. Also farmers are not adopting latest technologies like use of quality fodder seeds, leading to low productivity of green fodder. Besides, to meet the growing demand of humans for food, fiber and shelter, fodder production was never given due attention. The status of permanent pasture and common grazing lands are deteriorating due to huge grazing pressure, lack of adequate institutional arrangement, encroachment of land, etc. Poor awareness among farmers about various technologies is major obstacle to improve the availability and productivity of fodder.

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

⁵ <https://www.nddb.coop/sites/default/files/pdfs/guidelines/PIP-Vol-V-Guidelines-on-RBP-FD.pdf>

which has the potential of meeting fodder requirements during 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 under-utilized 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.

Several programmes and schemes for development of fodder and feed have been formulated and implemented under the five years plans⁶. Since 2014-15, Department of Animal Husbandry, Dairying and Fisheries (DADF) Government of India is implementing Centrally sponsored National Livestock Mission (approved outlay of Rs. 2800 crore) with sub-mission on Feed and Fodder Development (approved outlay of Rs. 465 crore). Under the sub-mission financial assistance is provided to the Animal Husbandry Departments of the States/UTs for feed and fodder development (GOI, 2016). However, very low allocation of funds for NLM and further lesser funds for sub-mission on fodder and feed development, has hampered the targeted impact of scheme. Due to this, efforts to improve production and availability of fodder by the Centre and State government prove to be insufficient to meet the demand of fodder. Therefore, under NDP I, fodder development programmes was formulated with the objective to enhance the fodder availability for the livestock.

1.2 Review of Literature:

It was observed that very few studies have been conducted and published by the researchers on estimation of feed and fodder though it accounts for the major share in cost of milk production. Also, availability of adequate quantity of feed and fodder for livestock is essential for improving the livestock productivity. As mentioned earlier, one of the major constraints to dairy production in India, particularly in resource-poor, rural areas, is a lack of feed and fodder for livestock⁷. Kannan (2002)

⁶ See Annexure I for ongoing programmes of DAD&F, GOI.

⁷ <https://tci.cornell.edu/blog/feed-and-fodder-scarcity-in-india-an-exploratory/>

studied the economics of fodder cultivation, processing of forages and its marketing aspects across districts in Karnataka. The study results shows that the total return from napier grass was higher than the variable cost of production indicating that its cultivation was relatively profitable among farmers. But, the estimated green fodder yield was very low at 65 quintal/acre. Since fodder jowar is cultivated in marginal lands, total variable cost of cultivation was low at Rs. 556/acre. The sample farmers used the harvested green fodders for feeding their livestock only and there was no organised market for it. However, a few farmers have sold dry fodders within the village. Hay making was the only processing method followed by the farmers in the study area. Among fodder types, farmers stored relatively large quantity of hay made from paddy straw for a maximum period of 220 days. (x) Availability of quality inputs and extension service delivery were reported to be major problems in the cultivation of fodder crops.

Birthal and Jha (2005) estimate that feed scarcity is the most important constraint in the dairy industry, and accounts for nearly half of all losses in Indian dairy production. Dikshit and Birthal (2010) estimated the feed consumption rates for different livestock species by age-group, sex, and function at the national level, and based on that the paper has generated demand for different types of feed by the year 2020. According to this study, by 2020 India would require a total 526 million tonnes (Mt) of dry matter, 855 Mt of green fodder, and 56 Mt of concentrate feed (comprising 27.4 Mt of cereals, 4.0 Mt of pulses, 20.6 Mt of oilseeds, oilcakes and meals, and 3.6 Mt of manufactured feed). In terms of nutrients, this translates into 738 Mt of dry matter, 379 Mt of total digestible nutrients and 32 Mt of digestible crude protein. The estimates of demand for different feeds will help the policymakers of the country in designing trade strategy to maximize benefits from livestock production.

Bhuyan and Baruah (2006) conducted study on locally available feed resources, feeding pattern, socio economic status and the problems of the 100 selected farmers of the hill zone of Assam comprising of Karbi Anglong and North Cachar districts. The study observed that paddy straw formed the main source of dry roughage. It was concluded that feed and fodder resources available in the region should be fed scientifically and judiciously, to improve the productivity of the animals which may in turn improve the socio-economic status of the farmers in the hill zone of Assam.

Grover and Kumar (2012) analysed the present status of fodder cultivation, profitability of fodder crops along with its processing and marketing practices in Gujarat, Madhya Pradesh, Karnataka and Punjab states of India. The study has been based on the experiences of 600 fodder growers, 150 from each state, scattered over different clusters along with few associated with fodder processing. The primary data pertaining to the year 2008-09 was collected by the personal interview method. The relative profitability analysis has highlighted that in Gujarat, during kharif season, net return per hectare from maize cereal crop came out to be Rs. 32775 which was higher by Rs.10821 compared to net return of Rs. 21954 from maize grown as pure green fodder. In rabi season, net return per hectare was Rs. 13828 for lucerne whereas it was Rs. 33922 for competing crop - wheat. In summer season, net return for study crop lucerne was only Rs. 6569 whereas it was Rs. 16246 for competing crop - jowar / sorghum grown as green fodder crop. In Madhya Pradesh, there was found no competition of fodder crops with other crops in the area under study. The comparative picture of fodder crops showed that the cultivation of berseem was found to be more profitable in the area under study in which an average fodder grower invested Rs.13835.66/ha and received Rs. 52521.47/ha revealed that on the investment of Rs. 1.00, farmer got Rs. 3.80 as benefit over the variable cost, while received only Rs. 1.80 and 1.69 on investment of Rs. 1.00 respectively from the cultivation of maize and jowar. The returns over variable cost fetched from paddy on per hectare basis were Rs. 10300 as compared to Rs. 552 for the jowar fodder in Karnataka. Farmers did not allocate higher area under fodder crops due to lower profitability in relation to their competing crops. In Punjab, the returns over variable cost fetched from paddy on per hectare basis were more than double than that of sorghum – the fodder crop. Berseem was found to be more remunerative as compared to sorghum but still the returns over variable cost were only 65 per cent as compared to the most important competing crop during the rabi season (wheat). The returns over variable cost for maize fodder were only 70 per cent as compared to maize grain during the summer season.

In Gujarat, inferior quality of seeds of fodder crops, non-availability of adequate quantity of required brand HYV seeds, the lack of technical knowledge, non-availability of market information in time and inadequate transport facility at reasonable rate were the major problems in production of fodder crops. In addition to

these, high expenditure in production due to power cuts and high cost of labour were the reported problems in Madhya Pradesh. In Karnataka, the inadequate access to credit, labour availability, and quality seed were the reported problems. In Punjab, poor quality and unrecommended varieties of seed, shortage of labour especially during harvesting of the crop, lack the technical knowledge and inadequate acquisition of credit were the major problems faced by the fodder growers. Similarly, in Punjab, Low price in the market, less remuneration, lack of market information and delayed payment for the produce by the commission agents in the market were reported as the major marketing problem. In Gujarat, it was suggested that government must evolve an arrangement to produce HYV seeds for fodder crops in adequate quantity and these should be made available at reasonable rate to the farmers. There is a need to adopt price mechanism which ensures higher or equal net returns at least to the one from competing cereal crops in order to divert more and more area to fodder crops. In Karnataka, concerted efforts should be made to encourage the farmers to cultivate green fodder crops by providing subsidized seed material and fertilizer coupled with technical trainings to group of potential farmers. In Punjab, availability of quality seedlings, high yielding varieties for various fodder crops, adequate short-term credit facilities to cover the operational cost along with required technical trainings can go a long way to augment the fodder area.

Raju (2013) assessed the availability of feed resources vis- a- vis livestock resources based on the secondary data of crop production, land utilization pattern and livestock census. Author noted that contrary to the belief that there has been a decline in the availability of feed resources, the data clearly shows that the overall dry matter availability from different sources has increased over the years from 341 million tonnes to 574 million tonnes,. The increased availability of feed resources was chiefly due to the increase in the crop residues and to a limited extent by increase in the concentrates. Availability of greens was more or less remained static over the years. The conventional feed resources enhancement on dry matter basis has to be achieved through giving weightage not only to grain yields but also to fodder quantity as well as quality. So emphasis in research could be to look for these qualities in the cultivars and promote their cultivation for enhanced supplies of crop residues. Although many non-conventional feed resources have been in use in many parts of the country, the extent of such use is not exactly documented. Their documentation is absolutely

essential in order to precisely assess the availability position. Further, there is need to have a documentation of the nutritional status and anti-nutritional factors that inhibit their usage. In the cultivated fodder production segment the use of multi-cut varieties can have significant contribution to fodder availability. In the forest lands many tree leaves have nutritional value well above the commonly available grasses in forests and degraded grazing and pasture lands. But very much less is known about their availability lesser on nutritional values. Tree leaves constitute quite a significant portion of livestock diet in arid and semiarid areas. Further in many parts of the country while feeding straws/stover, chaffing is not done thus leading to wastage and also more energy expenditure in chewing the unchaffed straw/stover. Mechanism for chaffed feeding should go a long way in reducing the wastage and energy conservation and use for other physiological functions of animals (Ramachandra et al, 2005). Considerable amount of nutrients are available and even supplied to animals in rural as well as in urban areas in the form of kitchen wastes, brewery waste, left over etc. But no information is available on this aspect. There is need to collect these data at micro level to make an assessment of availability of nutrients from this vital source. The livestock statistics which becomes available through census in five yearly intervals in terms of numbers and age groups has to be supplemented with average body weights of each age group. This helps in assessing the requirement of feeds and fodder more precisely. This is also required in order to have an assessment of regional variation due to various types of livestock species available in the country.

An expected deficit of 65 percent of green fodder and 25 percent of dry fodder is expected for Indian livestock by 2025 (Singh, et al., 2013). Additionally, increased pressure on land for production of human food crops from the increasing human population leaves little available land for further forage cultivation or feed production to nourish livestock. As a result, livestock predominantly depend on crop residues as their main source of feed (>44%) in much of India (Singh, et al., 2013), which are notoriously low in nutritional quality: high in fiber and low in crude protein. These issues coupled with a rise in demand for dairy products due to urbanization and human population growth have warranted research on better utilizing crop residues and improving diets for ruminants in India to increase milk production.

Vijay et al., (2014) had made compilation about production and supply of forage crop seeds and planting material done in the last five years. Authors noted that

even though there is huge demand for fodder and fodder seed it is not being transformed into breeder seed indent. The main reason for this low turnout is absence of organized market. The prevalence of niche markets for fodder seed resulted in low turnout of big companies in otherwise highly potential seed sector. The intrinsic problems in forage seed production ensued non inclination of both public and private sector resulting in reduced quality and competition. The absence of seed chain in range grasses and legumes hampers their multiplication. Only few public sector agencies like IGFRI and SAUs are producing grass seeds that to under truthful label (TL) category. Even though there is huge demand from the forest department, difficult production and harvesting procedures are deterring the seed sector to capture it. The fodder seed production is complicated compared to the regular field crops as the commercial product of fodder crops is vegetative part instead of seed and also the forage crops include grasses and legumes which are not domesticated and not under regular cultivation. Thus theseed production in fodder crops faces multifaceted challenges at different levels. Indian Grassland and Fodder Research Institute being a pivotal Institute working on fodder, has involved in fodder seed production and supply at different levels.

Chand et al (2015) estimated the district level availability and requirement of livestock feed and fodder in Rajasthan using secondary data of triennium ending 2008-09. Availability of dry fodder and concentrates were estimated using appropriate conversion ratios to different field crop production, while green fodder was estimated by applying per hectare yield to different fodder sources. The requirement was worked out by converting livestock into adult cattle units and multiplying by per unit consumption capacity. The annual availability of feed and fodder in the state was estimated at 51.54 million tonne is against the requirement of 68.61 million tonne and thereby deficit of around 25% per annum. The feed deficiency was estimated almost in all the districts except in the districts of Hanumangarh, Bikaner, Jaisalmer, Churu and Ganganagar. The eastern and south eastern districts were deficit in green fodder whereas western and southern hill districts were deficit in dry fodder. Other critical dimensions were low roughage: concentration ration (1:0.06) and high population pressure on pasture and grazing lands. The policies to develop silvi-pastoral model, creation of fodder banks/storage facilities, strengthening extension system, developing

drought resistant and high yielding variety, crop varieties with emphasis on fodder component needs priority attention.

Earagariyanna et al., (2017) had assessed the production and requirement of fodder in India using secondary data from NATP and 19th livestock census. The study results revealed that the fodder requirement in India is 883.95 Mt of green fodder and 583.66 Mt of dry fodder whereas the estimated fodder production is 664.73 Mt of green fodder and 355.93 Mt of dry fodder. Hence to minimize the existing gap of 218.22 Mt of green fodder and 227.73 Mt of dry fodder, adequate policy and research level initiatives have to be taken to strengthen the existing fodder resources. The findings of the study will help the policymakers of the country in designing trade strategy to maximize benefits from livestock production.

The 34th report of Parliamentary Standing Committee on Agriculture has also indicated shortage of 122 million tonnes dry fodder, 284 million tonnes of green fodder and 35 million tonnes of concentrate by 2024 (GOI, 2017). NITI Aayog in their Three Year Action Agenda 2017-2020 emphasized on shift into High Value Commodities, have indicated that an important challenge in the development of animal husbandry concerns fodder availability. Further, that the rapidly growing numbers of unproductive male cattle would add weak to the problem due to already existing weak fodder base due to problems in pasture management and shrinking of common properties which make the problem doubly serious. Therefore there is a need innovation in institutional aspects of pasture protection and management. Also necessary is greater co-ordination between agencies responsible for livestock and those for production of crops that produce fodder (GOI, 2017).

The National Action Plan on Fodder & Feed Security Programme (GOI, 2017) noted that the overall productivity of livestock has been low in past, because of inadequate nutrition from green fodder, along with dry residue and protein concentrate. As per NIANP –ICAR estimate, there is shortage of up to 36 % of Green fodder and protein concentrates besides upto 23% shortage of dry fodder. The green fodder shortage is due to impact of dwarf high yielding cereals crops (less short stock verses grains and hence less fodder material) apart from encroachment of over 10 million hectares of pasture land with poor replacement by agriculture land. The short length dual hybrid cereal crops also impact this availability. The problem is further compounded by lack of focus on scientific growth of fodder including required

agroclimatic varieties in over 105 arid and drought prone districts even while there is burning of available crop residues in fodder surplus States like Punjab and Haryana year after year. As a result, the cost of fodder is increasing at a much faster rate than price of milk thereby reducing profitability at the farmers level. The overall productivity of Dairy cattle is thus low because of inadequate nutrition from green fodder, along with dry residue and protein concentrate. Shortage of fodder is ordinarily observed during lean period which is more conspicuous in the flood & drought situation. Except preservation of crop residues in the forms of stalks at farmer level, the other preservation practices in the form of silage bales, fodder blocks, etc., are totally absent among farmers mainly due to lack of awareness about preservation techniques. Most of the crop residues are stored as dry fodder in the form of stalks.

Kumar et al (2018) studied the constraints facing in livestock Feed and fodder traders in Gujarat and noted that Feed and fodder are considered to be one of the key pillars of the livestock sector. The concentrate feed business is found to be somewhat organized but the trading is highly unorganized for all- feed as well as green and dry fodder business. An exploratory study was conducted to find out the constraints faced by the traders and the retailers of the livestock feed and fodder. Study was conducted in Gujarat during 2017 and 50 traders from 10 talukas (2 talukas from five selected districts) were interviewed using pre-structured survey schedule. The findings revealed that the biggest constraint perceived by the traders is less remunerative business of feed and fodder followed by presence of many competitors in the trading and retailing.

1.3 Need for the study

Dairy Industry in the country has shown spectacular growth during the last few decades. With an expected production of about 176 million MT of milk by the end of 2017-18, it is estimated that annual requirement of green fodder will be to the tune of 1,100 million MT and dry fodder to the tune of 610 million MT. The current availability of green and dry fodder, however, is estimated at 500 million MT and 380 million MT respectively. Efforts to increase livestock productivity / production is constrained by feed /fodder shortages. The shortages tend to be even more serious during natural calamities. To improve the availability of fodder, there is very little scope to increase the area under fodder cultivation, particularly in view of the growing demand of human beings for food, fiber and shelter. It is therefore necessary to

increase the availability of fodder by increasing the productivity of available forage resources per unit area, improve the efficiency of fodder utilization and minimize the fodder wastages to increase and thereby reduce the gap between demand and supply. The present average green fodder yield of 40 MT/hectare/year of cultivated land and 0.75 MT/hectare/year for common grazing land are too low and there is huge potential to improve their productivity through adoption of latest technologies.

The country's estimated demand for milk is likely to be about 200 million tonnes in 2021-22 (NDDB, 2014 & 2014a). To meet the growing demand, there is a need to increase the annual incremental milk production from 4 million tonnes per year as was the case for the last 10 years to 7.8 million tonnes in the next 8 years (total 210 million by 2021-22). To meet the growing demand, it is necessary to maintain the annual growth of over 4 per cent in the next 15 years. Quantum jump in milk production is possible through increase in productivity, and linking small holders to dairy cooperatives/producer groups/SHGs with forward linkages having milk processing facilities. Adequate availability of feed and fodder to livestock is vital to increase their productivity and also to sustain ongoing genetic improvement initiatives. The supply of feeds has always remained short of normative requirement (Jain *et al.* 1996, Singh *et al.* 1997, Ramachandra *et al.* 2007, Dikshit and Birthal 2010, Thirunavukkarasu *et al.* 2011, GoI 2012). The situation is further aggravated in Rajasthan and Gujarat where considerable area falls in arid and semi-arid zones. Keeping this background, the study examines demand, supply, and a deficit of feed and fodder production in the Gujarat.

1.4 Objectives of the Study

1. To analyze the growth trends of the area, production and productivity of green fodders, dry fodder crops and livestock.
2. To assess feed and fodder availability, requirement, deficit/surplus across all states to improve livestock productivity.
3. Estimating feed and fodder requirement for the future.

1.5 Data and Methodology

The study is based on both, the secondary and primary level data. The study is based on both secondary and primary level statistics. The secondary data on livestock population of all selected states are compiled from different Quinquennial Livestock

Censuses. The Census provides livestock population by region, species, sex, age, and purpose. For the present study, state and district-wise data on livestock population were collected from the Department of Animal Husbandry and Dairying, Government of Gujarat, Gandhinagar. Further, secondary data on the area under fodder were collected from various issues of Land Use Statistics and also from the concerned Department of Animal Husbandry, Dairy and Fishery for the study.

To understand and analyze the demand for and supply of feed and fodder, primary data were collected from the field level through a sample survey method. The reference period of the study was 2019-20 agricultural year. As per the sampling framework, three districts were selected from three regions of the state, i.e. Banaskantha (North Gujarat), Surat (South Gujarat), and Panchmahal (East Gujarat). The household survey was conducted covered the socio-economic characteristics of livestock farmers, availability, production and recommended practices of feed and fodder resources for their livestock. To meet the objectives of the present study, the primary and secondary data were collected, scrutinized, tabulated and analyzed by employing various analytical tools. The suitable analytical tools is employed for analysis of data as discussed briefly in the following subsections. The rate of growth was estimated to analyze the growth pattern between the inter-census periods of the livestock census (cattle, buffalo, sheep, and goat) in the state and country.

The following formula has been used for supply and demand projection of feed and fodder

$$Y_t = Y_0 * (1+r)^t$$

Where,

Y_t = Projection of feed and fodder for demand side/supply side

Y_0 = Requirement of feed and fodder in demand side at base year (Estimated value at demand side or use demand estimated formula)

r = Average annual growth of estimated demand for feed and fodder over the periods

t = numbers of years under projection

After projection of demand side of feed and fodder similarly supply side is calculated. Subsequently estimated the gap between demand and supply of feed and fodder.

1.5.1 Estimation of Supply of Feed and Fodder

1.5.1.1 Availability of Feed and Fodder (Supply)

The authentic data on fodder cultivation are not available across the country. Till date, there are no systematic efforts have been made by any government agencies to collect information on the feed and fodder area, production, and other related details. Nevertheless, Land Use Statistics of the Ministry of Agriculture, Government of India is the sole agency provides a data on the area under different crops cultivated in various Indian states for different years. According to this source, fodder crops occupied a meager 4.30 percent (average for the period 2005-06 to 2014-15) of the total cropped area in India.

With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data as estimated by the FAO (2012) and Ramachandra et al, (2007) as listed in the Table 1.25. The land utilization pattern data were classified as Gross Cropped Area (GCA), forest area, cultivable wasteland, permanent pasture, other fallows and area under trees from which green fodder is available for livestock feeding. The availability of green forages would be estimated as per the following classifications and assumptions as stated in Table. The fodder availability is calculated by using the following formula:

Fodder availability from land use = Respective land use * Green fodder production (tones/ha/year).

The total fodder availability from all the categories of classification is calculated by the following formula:

$$\text{Total Green fodder availability} = (A * 40.93) + (B * 1.50) + (C * 5.00) + (D * 1.00) + (E * 1.00) + (F * 1.00) + (G * 1.00).$$

Table 1.25: Green fodder yields for land use classification

Sl.no	Land use category	Green fodder (tones/ha/year)
A	Area under fodder crop	40.93
B	Forest area and on assumption that only 50% area was accessible for grazing	3.00 (1.50 if considered whole forest area)
C	Permanent pastures and other grazing lands	5.00
D	Cultivable wastelands	1.00
E	Current fallows	1.00
F	Other fallows	1.00
G	Misc. Tree Crops and Groves not Included in Net Area Sown	1.00

Source: FAO (2012), Ramachandra et al, 2007

1.5.1.2 Dry fodder & Concentrates:

The crop residues of various crops form a portion of dry fodder consumed by livestock and the quantum of available crop residues is often unable to be estimated directly, as it is seldom quantified. The Conversion factors in terms of harvest indices and extraction rates used in the calculation of feed resources such as crop residues, oil cakes, grains, brans and chunnies of various crops from crop production data in India (Table 1.26). Based on the ratios assessed and the data collected on the total food grains (cereals and pulses) and oilseed production in the State, the methodology for estimating dry fodder availability was framed as below. The dry fodder and concentrates availability from different crops are assessed from production data for the recent years by using following conversion of harvest and extraction ratio as per FAO (2012), Ramachandra et al., (2007). It would be assumed that 95 percent of crop residues are consumed by the livestock (CSO, 2012) and only 20 percent paddy straw is used for livestock and remaining is destroyed either by burning or other ways by the farmers (Sidhu et al., 1998, Gadde et al., 2009).

The dry fodder and concentrates feed to the livestock from the crop production data would be calculated by using the following formulation:

$$\sum_{ij} \text{ij}^{\text{mn}} [\text{QCij}] = ((\text{Yij} * \text{HIij or ERij}) - \text{NFWij})$$

where,

QCij, = Quantity of crop residues (dry fodder) and concentrates obtained from crop i in district j

Yij, = Yield of crop i in district j

HIij or ERij = Estimated conversion factor (harvest indices or extraction rate) for crop i

NFWij, = Quantity of 'i'th crop residues going for non-feed uses and wasted in district j

Table 1.26: Conversion factors in terms of Harvest indices and Extraction rates used

Crop	Harvest indices (HI)*		Extraction Rate(ER)	
	Crop residues	Oil Cakes	Grains	Brans and Chunnies
Paddy	1.30		0.02	0.08
Wheat	1.00		0.02	0.08
Sorghum	2.50		0.05	
Bajra/Pearl millet	2.50		0.05	
Barley	1.30		0.10	
Maize	2.50		0.10	
Ragi	2.00		0.05	
Small Millets	2.50		0.10	
Other cereals	2.00		0.10	
Pulses	1.70			0.03
Ground nut	2.00	0.70		
Oilseeds		0.70		
Sugarcane	0.25			

Note: *Harvest indices is the ratio of tones of utilized crop by-product to tones of primary crop harvested

1.5.1.3 Total Availability of Feed and Fodder

The dry matter in green fodder, dry fodder and concentrate is estimated as per the methodology adopted by the earlier workers (Ranjan et al., 1999, Anandan and Sampath, 2015, Tanver and Verma, 2017, FAO, 2012), wherein yield from green, crop residues and by-products would be calculated on the basis of dry matter (DM) yield assuming 25 percent, 90 percent and 90 percent DM, respectively. The factors for conversion of DM from each source into total digestible nutrients (TDN) are taken as 0.534 for green fodder, 0.476 for dry fodder, and 0.780 for concentrate feed. The factors for conversion of DM from each source into crude protein (CP) are 0.073, 0.016 and 0.180 for green fodder, dry fodder and concentrate feed, respectively (Dikshit and Birthal, 2010).

1.5.2 Estimation of Demand of Feed and Fodder

The estimation of demand of feed and fodder is worked out through different standards as estimated by the FAO, NATP and our own primary data with the help of livestock population data and their per day consumption in different stages of life, species, age and sex of the animal. The methodology is explained in detail as follows:

The Livestock Census, 2012 (GOI, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and State Department Animal Husbandry) was considered to find out the Ruminant Livestock Unit (RLU). This Livestock population in the state is converted into a standard Ruminant Livestock Unit (RLU) according to species, age and sex (male and female) as per Ramachandra et al., 2007 study and FAO Animal Production and Health manual.

The estimation of feed requirement for the livestock is worked out only for a major ruminant species such as cattle, buffalo, sheep, and goats as they consume a major share of feed resources available. The body size and their dry matter requirement of cattle, buffalo, sheep, and goats have been worked out based on standard Ruminant Livestock Units (RLU) to minimize the variations. A cattle weighing 350 kg body weight is assumed to represent one standard RLU and district wise fodder requirement for ruminants (cattle, buffaloes, sheep and goats) were calculated on the basis of Ruminant Livestock Unit (RLU) of 350 kg body weight by assuming 2 percent dry matter intake per day for every Ruminant Livestock Unit (7 kg dry matter for 350 kg body weight) which is in accordance with Devendra (1997),

Raju et al, (2002), FAO (2012), and Ramachandra et al.,(2007). The following conversion factors are used for calculating the RLUs as given in Table 1.27.

The total requirement of feed and fodder is calculated using the standards given by the NATP database as provided in Table 1.28. The animals' category-wise data is collected from the Animal Husbandry Department and the requirement of feed and fodder is calculated individually and the aggregate demand is calculated by summing up of all categories. Further, an attempt is also made to estimate the demand of feed and fodder through the primary data collected from our sample households representing a major ruminant species such as cattle, buffalo, sheep, and goats only. The detailed sample selection and location of sample districts is given in Table 1.29 & Map 1.1.

Table 1.27: Conversion factors for calculating Ruminant Livestock Unit (RLUs)

Sl. No	Species	Age (Years)	Conversion factor
A	Buffalo	>2.5	1.14
		1.0-2.5	0.50
		< 1.0	0.17
B	Cattle	>2.5	1.00
		1.0-2.5	0.34
		<1.0	0.11
C	Sheep/goat	>1.0	0.10
		<1.0	0.03

Table 1.28: Quantities of feed fed to different species within household premises (kg/animal/day)

Animal category	Feed types			Nutrients		
	Green fodder*	Dry fodder	Concentrates	Dry matter (DM)	Total digestible nutrients (TDN)	Digestible crude protein (DCP)
Cattle						
In-milk	4.75	5.50	0.64	6.71	3.44	0.27
Dry	3.40	4.02	0.40	4.83	2.46	0.18
Adult male	4.06	6.03	0.33	6.74	3.36	0.21
Young stock	2.18	2.13	0.18	2.62	1.33	0.10
Buffalo						
In-milk	5.96	6.34	1.05	8.14	4.25	0.37
Dry	5.44	4.95	0.52	6.28	3.21	0.25
Adult male	4.04	7.47	0.36	8.06	3.99	0.24
Young stock	2.29	2.22	0.19	2.74	1.39	0.10
Goat	1.04	0.20	0.06	0.49	0.27	0.03
Sheep	1.01	0.20	0.04	0.46	0.24	0.03
Others**	2.35	6.72	0.49	7.08	3.54	0.22

Source: NATP project database (Dikshit and Birthal, 2010).

Notes:* includes cultivated fodder and the fodder gleaned and gathered from cultivated and uncultivated lands.

Surplus / deficit/ gap of Feed and Fodder

The percent gap between the requirement and availability has been computed as,

$$\text{Percent of gap} = \frac{\text{Requirement of fodder} - \text{availability of fodder}}{\text{Requirement of fodder}} * 100$$

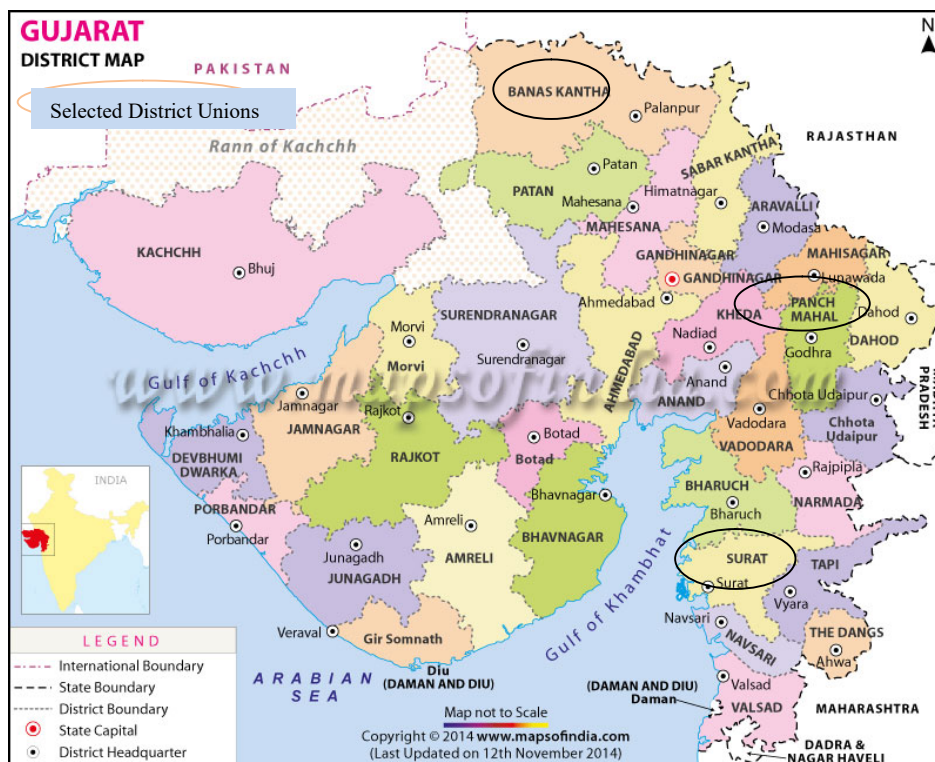
1.5.3 Sampling Framework

The study is conducted in the state of Gujarat. For the study, districts were selected based on the Livestock population from the available secondary data. The proportionate sampling technique was applied to select the sample districts in selected states. To select districts for the study, districtwise animal population was compiled. Based on the size of the population of Cattle, Buffalo Sheep and Goats ranks had been given to individual districts and then average of the obtained ranks of individual district was considered. The districts having top three ranks were selected for the study. The number of farmers surveyed is mainly based on proportion of cattle, Buffalo and Sheep & Goat population existing in the district i.e. in selected districts of Gujarat based on proportion population sample size is determined. Villages were selected based on the density of the animal population details existed in the district animal husbandry department. The cattle rearing farmers includes both cross breed and indigenous cows, bulls and oxen or calves, if farmer rearing all kinds of animals means he/she was considered as more than one sample. The selected farmers were surveyed with a pre prepared questionnaire.

Table 1.29: Details on Selected Districts, Taluk and Villages

Sr. No.	District	Taluk	Village name	Selected HH			ALL HH		
				B	C	SG	T	(Multiple)	
1	Banaskantha	Deesa	Aseda	5	4	11	20	15	
			Dharpada	1	1	0	2	1	
			Dhuva	4	0	4	8	4	
			Juna Deesa	0	4	12	16	12	
				Nava	39	32	1	72	41
			Dhanera	Voda	37	40	12	89	45
			Tharad	Budhanpur	3	4	7	14	7
				Janadi	2	1	7	10	7
				Moti Pavad	27	16	0	43	28
				Total	118	102	54	274	160
2	Panchmahal	Godhra	Mehlol	15	15	20	50	33	
			Halol	Arad	18	13	23	54	32
			Shahera	Aniad	21	20	20	61	24
			Total		54	48	63	165	89
3	Surat	Choriasi	Kanej Paradi	5	4	6	15	13	
			Mandavi	Amalsadi	7	9	5	21	17
			Mangrol	Rankapur	4	4	5	13	12
			Total		16	17	16	49	42
4	Grand Total			188	167	133	488	291	

Map 1.1: Location Map of Study Area in Gujarat, India



1.6 Organization of Report

The present study report is divided into six chapters including this introductory chapter. The introductory chapter presents the introductory notes, need and scope of the study and sets out the main objectives of the study. It is also present the data and methodology used for selection of districts/blocks/sample households, sample size, analytical and conceptual framework and concepts used in the study. Chapter two presents macro overview of dairy development in the state of Gujarat. It also analyse major trends in dairy sector, GDP, livestock production and milk productivity in selected districts using secondary data. The socio – economic characteristics of sample households are presented in Chapter III. Chapter IV covers estimation of area production and productivity of fodder and feed crops being fed to livestock by sample households. Chapter V presents the constraints, views and suggestions given by the sample households. Chapter VI presents the conclusions and recommendations emerged from the study.

The next chapter presents the dairy development in Gujarat state.

Dairy and Fodder Development in Gujarat

2.1 Introduction:

Gujarat has been consistently clocking impressive agricultural growth rates. This has been possible because the government has focused on improving not only irrigation, quality of seeds and power but also subsidiary sectors like animal husbandry. The growth of the animal husbandry sector has resulted not only in increased milk production but has also provided a boost to the overall agro-economy of the state¹. The livestock sector in Gujarat has achieved a remarkable success during last six decades due to collective efforts of government organisations, non-government organisation and the milk producers. Gujarat is one of the leading states in terms of milk production. The cooperative sector has been the key driver of the tremendous increase in Gujarat's milk production. It is not a surprise that Gujarat, the birthplace of India's white revolution, has a thriving milk cooperative sector. The largest dairy co-operative in India, Amul, is based in Anand, Gujarat. 'Amul' pattern is well known & accepted by all states in India besides some of the countries in the world².

Gujarat with geographical area of 19,60,924 square kilometres accounts for 6.19 per cent of total geographical area of India. It has 33 districts, including 7 newly carved out districts and 248 talukas. It falls in 13th Agro climatic zone of India which is further divided into eight sub zones. Gujarat has the longest coastline of 1600 kilometres which is about 20 per cent of country's total coastline. As per 2011 census, the population of the State was 6.04 crore out of which 47.85 per cent population were females (2.89 crore). Half of the population is distributed across seven districts, viz. Ahmedabad, Surat, Vadodara, Rajkot, Banaskantha, Bhavnagar and Junagadh. Poverty head-count ratio of the State stands at 23.0 per cent. The literacy rate in the State was 78.03 per cent (2011). As elsewhere, urbanisation is on the rise, with urban areas accounting for 43 per cent of the population. The State economy is among the top four major state economies and at current prices, it contributes to about 7.6 per cent to the National GDP during the year 2016- 17, despite the State accounts for 4.99 per cent to country's total population. The Per Capita Income (i.e. Per Capita NSDP

¹ <http://gujaratindia.com/media/news.htm?NewsID=OwAhuSgQW4gO/FwV0IqgsQ==>

² <https://doah.gujarat.gov.in/dairy-development.htm>

at market prices) at constant (2011-12) prices has been estimated at Rs. 132773 in 2016-17 as against Rs. 122148 in 2015-16, registering a growth of 8.7 per cent during the year. The per capita income at current prices has been estimated at Rs. 156691 in 2016-17 as against Rs. 140273 in 2015-16, showing an increase of 11.7 per cent during the year (GOG, 2018).

2.2 Role of Dairy Sector in State Economy of Gujarat:

Animal husbandry has played a significant role in boosting the agrarian economy of the state. It is not only a subsidiary source of livelihood in rural Gujarat, it is a major economic activity, especially in the arid and semi-arid regions of the state. Thus, this sector plays a vital role in the rural economy of the state and has significant impact on employment generation for marginal, sub-marginal and landless farmers. Out of about total 102 lakhs household, about 43 lakh households have livestock in Gujarat as a primary or secondary source of income.

Animal husbandry plays a vital role in Gujarat's rural economy contributing 5.32 per cent to the state GSDP in 2013-14, while the contribution of agriculture to total GSDP was 16.83 per cent. The contribution of agriculture and livestock to total GSDP was estimated to be 22.15 per cent, while contribution of livestock to agriculture and livestock together was around 24 per cent. Thus, one fourth of the agriculture sector output comes from livestock sector (Table 2.1 and Fig. 2.1). The share of GVO from livestock to agriculture sector and livestock has been fluctuating over the last one and half decade and remains between 20-30 per cent. However, the contribution of gross value added from agriculture and livestock to total GSDP has increased from 14.54 per cent in 1999-2000 to 18.57 per cent in 2013-14. Gujarat accounts for 6.53 per cent share in value of output from livestock (at current prices) of country, while its share was 7.98 per cent in total value of output from agriculture and livestock of the country in 2013-14.

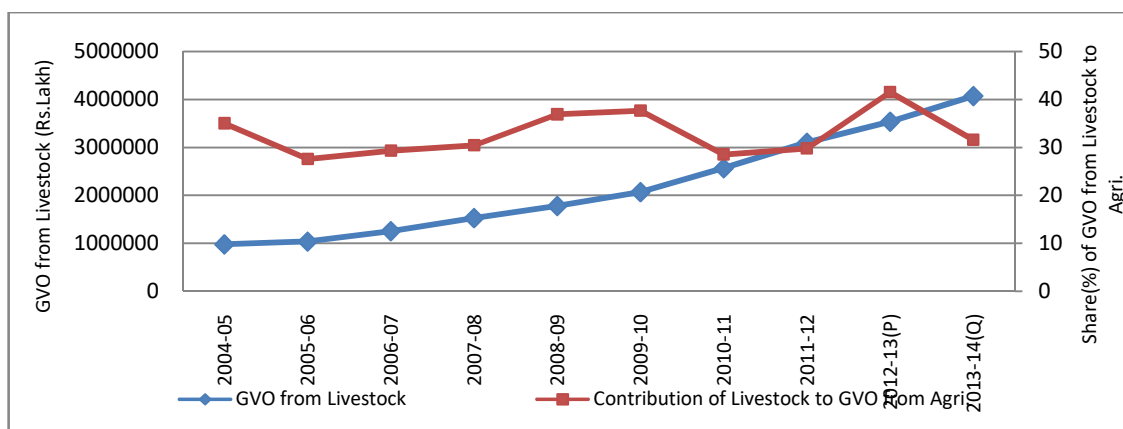
Milk contributes around 20 per cent to the agricultural GSDP of Gujarat and is one of the biggest sectors for supporting livelihood in the state. Livestock output at constant prices was reported at Rs. 141 billion in 2011-12 (at constant prices), which accounted for around 21.8 percent of the total output of agriculture and allied sector. Share of milk at constant prices was about 86% or Rs. 122 billion, which was not only the highest contribution but also was a noticeable share in the total livestock output (Table 2.1).

Table 2.1: Contribution of Gross Value of Output and Gross Value Added from Agriculture and Livestock Sector to total GSDP at Current Prices of Gujarat State

Sr. No	Year	Total GSDP (Rs In Crores)	Contribution of GVO from Agriculture to Total GSDP (%)	Contribution of GVO from Livestock to Total GSDP (%)	Contribution of GVO from Agriculture & Livestock to Total GSDP (%)	Contribution of GVA from Agriculture & Livestock to Total GSDP (%)	Contribution of GVO from Livestock to Agriculture & Livestock sector (%)
1	1999-00	1,09,861	15.40	5.21	20.61	14.54	25.28
2	2000-01	1,11,139	13.14	5.64	18.78	13.28	30.02
3	2005-06	2,44,736	15.37	4.24	19.62	14.43	21.63
4	2010-11	5,21,519	17.23	4.92	22.15	18.03	22.22
5	2013-14	7,65,638	16.83	5.32	22.15	18.57	24.01

Source: GOG (2015)

Fig. 2.1: Contribution of Gross Value of Output from Livestock sector to Agriculture (At current price) in Gujarat: 2004-05 to 2013-14



Source: GOG (2015)

Map 2.1: Animal Husbandry Map of Gujarat



Source: <http://glpc.co.in/showpage.aspx?contentid=22&lang=Gujarati>

Milk was followed by meat (5 percent), dung at 1.9 percent is also considerable share and eggs at 1.7 percent followed. While the share of milk has remained consistent the share of dung has greatly reduced, as also a reduction in meat was observed amidst fluctuations, whereas the share of eggs observed a rise consistently during the period 2004-05 to 2011-12. All of these estimates are at constant prices of 2004-05. At current prices that share of meat and dung was observed to be higher.

Table 2.2: Value of Output: Agriculture and Livestock

Item	Value of Output: Agriculture and Livestock in Gujarat							
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Value of Output at Current Prices (Rs. billion)								
Agriculture & Allied*	448	565	644	735	743	859	1274	1464
Agriculture	278	376	421	492	476	549	898	1030
Livestock	99	106	127	156	178	207	257	310
Share of Value of Output to Agriculture and Allied* (%)								
Agriculture	62.1	66.5	65.4	66.9	64.1	63.9	70.5	70.4
Livestock	22.1	18.8	19.7	21.2	24	24.1	20.2	21.2
Value of Output at Constant Prices (Rs. billion) (2004-05)								
Agriculture & Allied*	449	430	494	556	526	513	628	647
Agriculture	278	350	307	361	318	312	424	437
Livestock	99	105	112	118	129	133	134	141
Share of Value of Output to Agriculture and Allied* (%)								
Agriculture	61.9	81.4	62.1	64.9	60.5	60.7	67.6	67.6
Livestock	22	24.4	22.7	21.2	24.5	25.8	21.3	21.8
Share of Livestock Output at Current Prices (%)								
Milk	86.2	85.1	83.8	85.1	81.2	82	83.5	82.2
Meat	6.4	6.9	8.5	7.7	11	9	7.9	9
Egg	0.8	0.9	1.1	1	1.6	1.5	1.6	1.6
Dung	4.1	4.4	3.9	3.4	3	2.8	2.4	2.3
Others^	2.5	2.8	2.7	2.8	3.2	4.6	4.7	4.9
Share of Livestock Output at Constant Prices (%)								
Milk	86.2	85.6	84.2	84.1	81.5	83.2	86.6	86.3
Meat	6.4	6.7	8	8.1	10.7	8.6	4.9	5
Egg	0.8	0.9	1.1	1.1	1.6	1.6	1.6	1.7
Dung	4.1	4.1	4	3.8	3.4	1.9	1.9	1.9
Others^	2.5	2.7	2.7	2.9	2.7	4.7	5	5.1

Notes: P: Provisional Estimates, Q: Quick Estimates, * Includes Livestock, Forestry & Fisheries, ^ Includes Wool and Hair, Silkworm Cocoons & Honey, Increment in Stock

Source: NDDDB (20014), Dairying in Gujarat: A Statistical Profile 2013.

2.3 Growth Pattern of major Livestock Population in the State

Gujarat State has secured a remarkable position in the country as far as livestock wealth and development are concerned. As per Provisional figures of the 20th Livestock Census (2017) of India, total livestock population was estimated to be 535.78 million, out of which, 26.9 million livestock (5.02 %) population was in the

state of Gujarat (Table 2.3). As per 19th Livestock Census (2012), the state accounted for 5.23 per cent share in cattle population, 9.55 per cent of buffalo population, 2.62 per cent sheep population and 3.67 per cent goat population of the country. The significant share of donkeys (12.18 %) and camels (7.80 %) in national stock is also noteworthy (2012). An increase in livestock population from 23.51 million in 2007 to 27.12 million in 2012 was observed (excluding 0.29 million stray cattle) registering a positive growth of 15.36 per cent in the total number of animals of various species (Table 2.3), while same as declined by 0.84 per cent between 2012 and 2017. In fact, the share of Gujarat in all India total stock of livestock increased by 0.86 percent points during 2007 to 2012 and then declined by 0.28 percent points in 2017.

Table 2.3: Growth of the Livestock in Gujarat and India

Sr. No	Livestock Census Year	Total Livestock (in '000)		% Share of Gujarat to All India	% Growth of Gujarat between two Census
		All India	Gujarat		
1	1951	292784	11977	4.09	-
2	1956	306615	13312	4.34	11.15
3	1961	336432	13454	4.00	1.07
4	1966	344111	14338	4.17	6.57
5	1972	353338	15098	4.27	5.30
6	1977	369525	14406	3.90	-4.58
7	1983	419588	18440	4.39	28.00
8	1987	445285	17343	3.89	-5.95
9	1993	470830	19672	4.18	13.43
10	1997	485385	19939	4.11	1.36
11	2003	485002	21671	4.47	8.69
12	2007	529698	23515	4.44	8.51
13	2012	512057	27128	5.30	15.36
14	2017 (P)	535780	26900	5.02	-0.840

Notes: Figures without Dog & Rabbit; P- Provisional

Source: GOI (2016) & GOG (2017).

Table 2.4: Species-wise Livestock population & its Share in total livestock

Sr. No.	Particulars	Gujarat -2012 (in '000)				India 2012 (in '000)	
		Livestock-2012	% share in India	% share in total	Rank in All India	Livestock-2012	% share in Total
1	Cattle	9984	5.23	36.80	9	190904	37.28
2	Buffaloes	10386	9.55	38.29	4	108702	21.23
3	Sheep	1708	2.62	6.30	7	65069	12.71
4	Goats	4959	3.67	18.28	12	135173	26.40
5	Pigs	4	0.04	0.01	29	10294	2.01
6	Horses & Ponies	18	2.88	0.07	9	625	0.12
7	Mules	0	0.0	0.00	-	196	0.04
8	Donkeys	39	12.23	0.14	3	319	0.06
9	Camel	30	7.5	0.11	2	400	0.08
10	Yaks	0	0	0.00	-	77	0.02
11	Mithun	0	0	0.00	-	298	0.06
12	Total Livestock	27128	5.3	100.00	9	512057	100.00

Note: Figures without Dog & Rabbit.

Source: GOI (2016) & GOG (2017).

As per Livestock Census 2012, among various species in Gujarat livestock, buffalo comprised of the highest share (38.28 per cent) in total livestock population followed by Cattle (36.80%), Goat (18.28 %) and Sheep (6.30 %), besides marginal share of other livestock species such as Camel, Mules, Donkeys, Horses and Ponies (Table 2.4). The females among the indigenous cattle, crossbred and buffalo population numbered 5.03 million, 1.73 million and 9.6 million, respectively. An increase of 15.36 per cent was observed in livestock population during 2007 to 2012. The highest growth in population was recorded in cattle population (25.18 %) followed by buffalo (18.37 %) and goat (6.88 %), while sheep population registered decline (-14.69 %). However, share of cattle population in total livestock population declined from 44.6 per cent in 1951 to 36.8 per cent in 2012, while share of buffalo population increased considerably (21% to 38.3%) during corresponding period. In absolute term, the rate of increase in buffaloes population (313 %) was much faster as compared to rate of increase in cows' population (87%). In case of small ruminants, sheep population increased by 8.6 per cent while goat population declined by 6 per cent during 1951 to 2012 (Fig. 2.2 and table 2.5). Total livestock population in Gujarat increased by 127 per cent during last six decades (Table 2.5).

Table 2.5: Growth in Livestock Population in Gujarat- 1951 to 2012

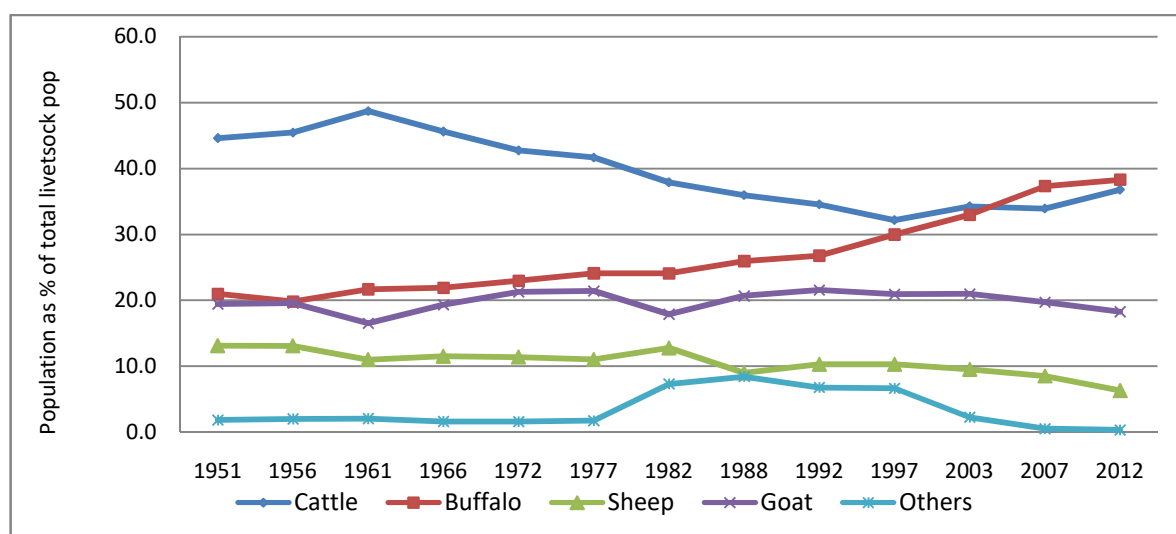
Sr. No.	Year	Cattle		Buffalo		Sheep		Goat		Total Livestock	
		Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)
1	1951	5345	-	2514	-	1574	-	2326	-	11977	-
2	1956	6055	13.28	2640	5.01	1744	10.80	2606	12.04	13312	11.15
3	1961	6557	8.29	2917	10.49	1481	-15.08	2223	-14.70	13454	1.07
4	1966	6544	-0.20	3140	7.64	1652	11.55	2771	24.65	14338	6.57
5	1972	6457	-1.33	3468	10.45	1722	4.24	3210	15.84	15098	5.30
6	1977	6006	-6.98	3473	0.14	1592	-7.55	3084	-3.93	14406	-4.58
7	1982	6994	16.45	4443	27.93	2357	48.05	3300	7.00	18440	28.00
8	1988	6240	-10.78	4502	1.33	1559	-33.86	3584	8.61	17343	-5.95
9	1992	6803	9.02	5268	17.01	2027	30.02	4241	18.33	19672	13.43
10	1997	6749	-0.79	6285	19.31	2158	6.46	4386	3.42	20970	6.60
11	2003	7424	10.00	7140	13.60	2062	-4.45	4541	3.53	21655	3.27
12	2007	7976	7.44	8774	22.89	2002	-2.91	4640	2.18	23515	8.59
13	2012	9984	25.18	10386	18.37	1708	-14.69	4959	6.88	27128	15.36

Notes: Nos are in thousand; GR- Growth rate in per cent over previous year.

Source: GOG (2017).

The district-wise share in total state livestock population figures (Fig. 2.2 & Table 2.6) indicate that Banaskantha (9.38 %) had the highest number of livestock population followed by Panchmahal (7.41%), Kachchh (7.14%), Sabarkantha (6.8%), Dahod (6.41%) and Vadodara (6.13%). These six districts together accounted for 44 percent of total livestock population in the state in 2012 (Fig. 2.3).

Fig 2.2: Species-wise Share in Total livestock Population in Gujarat (1951-2012)



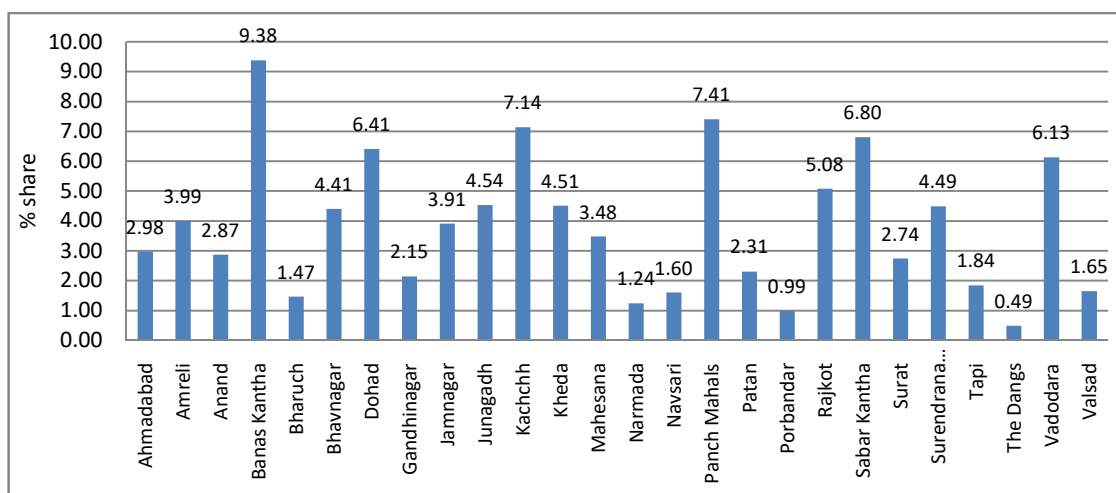
Source: GOG (2017).

Table 2.6: District wise Percentage share of Animals in Total Livestock Population

District	District wise Percentage share of animals in Total livestock population in Gujarat-2012										
	CB	IND	COWS	Buffalo	Sheep	Goat	Pigs	Horses & Ponies	Mules	Donkey	Camel
Ahmedabad	2.15	28.56	30.71	48.80	2.05	17.83	0.14	0.16	0.00	0.20	0.10
Amreli	0.68	39.09	39.77	30.05	12.95	17.02	0.00	0.16	0.00	0.05	0.00
Anand	13.37	13.79	27.15	62.40	0.65	9.03	0.00	0.03	0.00	0.64	0.10
Banaskantha	15.04	22.48	37.52	46.05	4.55	11.61	0.00	0.04	0.00	0.06	0.17
Bharuch	6.58	25.09	31.67	33.26	0.80	33.52	0.07	0.19	0.00	0.34	0.14
Bhavnagar	0.88	33.86	34.74	33.08	14.61	17.34	0.00	0.14	0.00	0.06	0.03
Dahod	0.30	39.46	39.77	20.80	0.29	39.03	0.00	0.00	0.00	0.11	0.00
Dang	7.50	51.26	58.76	18.62	0.00	22.23	0.35	0.02	0.00	0.01	0.01
Gandhinagar	15.37	12.26	27.63	56.84	2.44	12.71	0.00	0.04	0.00	0.14	0.19
Jamnagar	0.12	34.68	34.81	28.21	20.04	16.60	0.02	0.07	0.00	0.07	0.19
Junagadh	2.22	42.76	44.97	40.21	3.55	11.08	0.00	0.07	0.00	0.04	0.07
Kachchh	0.26	29.74	30.00	19.34	29.48	20.48	0.02	0.11	0.00	0.17	0.41
Kheda	9.87	14.69	24.57	61.95	1.81	10.97	0.00	0.03	0.00	0.55	0.13
Mehsana	17.08	12.90	29.98	57.03	1.33	10.88	0.00	0.10	0.00	0.18	0.50
Narmada	1.37	50.54	51.90	23.67	0.12	24.21	0.00	0.02	0.00	0.08	0.00
Navsari	41.59	11.91	53.50	26.44	0.48	19.43	0.10	0.02	0.00	0.03	0.00
Panchmahal	4.76	28.76	33.52	36.51	0.11	29.74	0.00	0.01	0.00	0.10	0.00
Patan	2.25	18.57	20.82	59.52	6.03	12.84	0.00	0.11	0.00	0.25	0.43
Porbandar	0.17	30.04	30.21	54.08	8.35	7.03	0.04	0.12	0.01	0.01	0.15
Rajkot	2.21	39.50	41.70	31.36	14.24	12.52	0.00	0.10	0.00	0.05	0.02
Sabarkantha	14.41	23.96	38.37	39.91	3.35	18.06	0.01	0.03	0.00	0.17	0.09
Surat	18.67	20.21	38.88	40.34	0.23	20.21	0.07	0.14	0.00	0.11	0.01
Surendranagar	0.32	40.06	40.39	36.65	7.47	15.23	0.00	0.17	0.00	0.07	0.02
Tapi	22.49	24.53	47.02	34.49	0.03	18.44	0.00	0.01	0.00	0.01	0.00
Vadodara	2.17	34.39	36.56	36.40	0.38	26.34	0.04	0.03	0.00	0.24	0.01
Valsad	19.06	35.57	54.63	17.07	0.86	27.40	0.01	0.02	0.00	0.01	0.00
Gujarat State	7.33	28.88	36.21	38.08	6.50	18.87	0.02	0.07	0.00	0.15	0.12

Source: NDDDB (2014)

Fig.2.3: Districtwise Share in Total Livestock Population in Gujarat 2012 (%)



Source: GOG (2017).

Table 2.7: District-wise Livestock and Bovine Density (1992-2012)

Districts	Livestock (No. per sq km)					Bovine (No. per sq km)				
	1992	1997	2003	2007	2012	1992	1997	2003	2007	2012
Ahmedabad	89	66	83	89	100	64	50	62	69	79
Amreli	102	110	98	100	147	65	66	58	63	114
Anand	-	-	176	222	243	-	-	144	188	218
Banaskantha	124	136	162	201	237	70	72	112	150	198
Bharuch	73	65	67	65	61	49	29	42	42	40
Bhavnagar	103	104	118	114	119	53	54	64	68	81
Dahod	-	-	307	391	478	-	-	199	239	289
Gandhinagar	186	172	233	272	272	156	141	201	237	230
Jamnagar	60	64	70	71	75	33	35	40	43	47
Junagadh	96	88	110	116	139	74	69	86	97	120
Kachchh	31	36	33	37	42	10	12	11	13	21
Kheda	157	175	201	240	309	132	142	163	203	268
Mehsana	130	169	172	205	214	103	142	146	179	187
Narmada	-	-	122	99	120	-	-	84	73	91
Navsari	-	-	176	150	194	-	-	127	117	155
Panchmahal	230	201	312	323	384	159	143	223	231	269
Patan	-	-	90	116	108	-	-	59	86	87
Porbandar	-	-	101	105	116	-	-	73	82	98
Rajkot	104	102	110	111	123	58	59	64	73	90
Sabarkantha	170	187	227	248	250	121	140	172	189	195
Surat	102	118	137	77	164	80	90	106	62	130
Surendranagar	65	68	77	92	117	38	42	47	61	94
Tapi	-	-	-	-	159	-	-	-	222	130
The Dangs	71	71	88	77	75	11	11	15	12	58
Vadodara	138	140	159	168	220	144	150	279	311	171
Valsad	163	144	151	186	149	118	99	106	133	107
Gujarat	94	101	110	112	138	62	66	74	72	104

Source: NDDB (2014).

Banaskantha had the highest number of in-milk buffaloes and cows followed by Sabarkantha and Mehsana district. Sabarkantha had the highest number of in-milk

crossbreds and Kachchh had the highest in-milk indigenous cattle. In-milk indigenous cattle like Gir are predominantly spread across Saurashtra region covering Rajkot, Junagadh and Bhavnagar districts of Gujarat, whereas Kankrej are found mostly in northern Gujarat and Kachchh region. As depicted in Table 2.7, the highest livestock and bovine animal density was recorded in Dahod district. India has a total 137 breeds of domesticated animals, of which about 18 breeds, including some internationally recognised ones, are available in Gujarat. The State has high-quality, high-yielding breeds of cattle and buffaloes (Table 2.8).

Table 2.8: Distribution of Gujarat's Cattle Breeds

Breeds	Breeding Tract	Utility	Distribution
A) Cattle			
Gir	Junagadh, Bhavnagar, Amreli, Porbandar and Rajkot districts.	Milch	Rajasthan, Madhya Pradesh and Maharashtra. Exported to Brazil, Mexico, USA and Venezuela.
Kankrej	South-west Rann of Kachchh comprising Mehsana, Kachchh, Ahmedabad, Kheda, Sabarkantha and Banaskantha districts.	Dual	Western Rajasthan. Nomadic herds of this breed are also found in Madhya Pradesh, Maharashtra, Uttar Pradesh, Haryana.
Dangi	The Dang, Valsad, Panchmahal and Dahod districts. Sizeable numbers of this breeds are also found in Nasik and Ahmednagar districts of Maharashtra.	Draught	Parts of northern Maharashtra
B) Buffalo			
Jaffrabadi	Found in Junagadh, Amreli, Bhavnagar, Porbandar and Rajkot districts.	Milch	Bulls and herds of this breed have been introduced for breed improvement programmes in Maharashtra.
Mehsana	Found in Mehsana, Patan, Banaskantha and Sabarkantha districts.	Milch	Northern Gujarat
Surti	Found in Kheda, Anand, Vadodara, Bharuch and Surat districts.	Milch	In the border districts of Rajasthan.
Banni	Found in Kachchh and Patan districts.	Milch	Kachchh

Source: AE Nivsarkar *et al.*, (2000), Animal Genetics Resources of India, Cattle and Buffalo, ICAR publication, as mentioned NDDB (2014).

Gir and Kankrej breeds in cows, and Mehsani, Jafarbadi and Surti breeds in buffaloes are known for their high milk yielding capacity. Gir and Kankrej breeds are dual purpose breeds. Gir breed is found in Amreli, Bhavnagar, Junagadh, Jamnagar, Rajkot and Surendranagar districts. In rest of the districts of Gujarat, Kankrej breed is found along with non-descriptive breed. The Surti breed is found in Bharuch, Kheda, Surat, Vadodara, Panchmahal etc, whereas the Mehsani breed is found in Mehsana, Sabarkantha, Banaskantha and Ahmedabad. In respect of the population of buffaloes in the state, Kheda district ranks first, followed by Mehsana and Sabarkantha district. With the recognition of the Banni breed by the National Bureau of Animal Genetic Resources (NBAGR), Gujarat is now home to four major buffalo breeds of the total 12 recognised breeds in India. The performance of these breeds is presented in Table 2.9.

Map 2.2: Districtwise Yield of Species

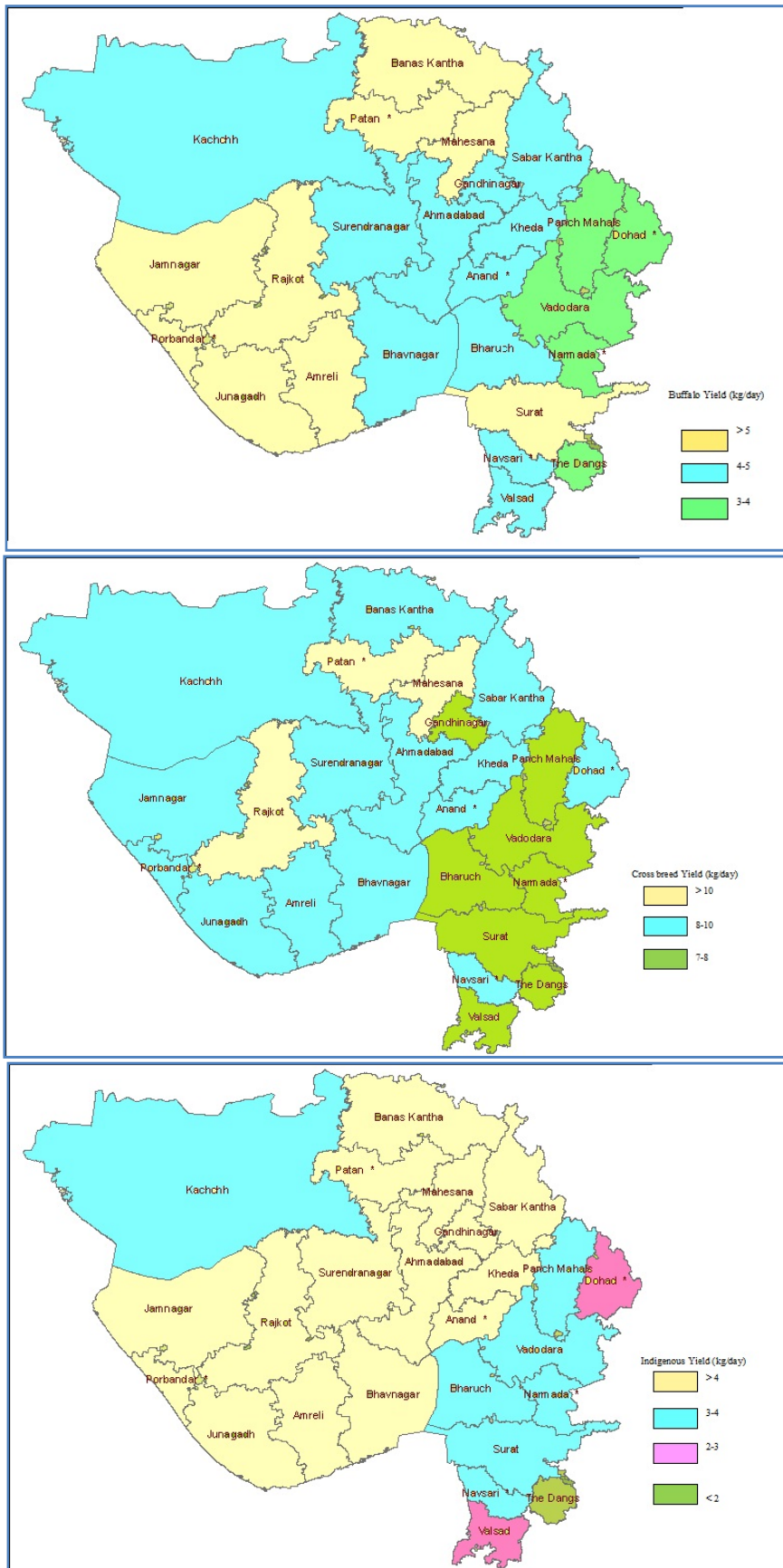


Table 2.9: Comparison of Yield related attributes of Cattle and Buffalo Breeds

Parameter	Cattle			Buffalo			
	Gir	Kankrej	Dangi	Jaffrabadi	Mehsana	Surti	Banni
Breed Pop ('000)	1,400	2,682	209	1,470	3,370	1,557	525
Lactation Yield(kg)							
Field	2,790 (2,732 to 3,312)	2,396 (2,137 to 2,864)		3,189 (3,047 to 3,639)	3,426 (3,163 to 3,488)	2,405 (2,262 to 2,792)	2,860 (2,770 to 22,950)
Farm	2,125 (1,835 to 2,950)	1,954 (1,271 to 232)	530 (32 to 1,228)	1,967 (1,917 to 2,075)	1,840 (1,774 to 1,904)	1,699 (1,399 to 1,955)	
Lactation Length(days)	305 (302 to 329)	314 (308 to 329)	269 (100 to 396)	325 (316 to 328)	315 (312 to 327)	310 (308 to 323)	300 (296 to 304)
Calving Interval (days)	435 (420 to 480)	424 (312 to 565)	474 (464 to 484)	482 (476 to 494)	394 (385 to 403)	424 (418 to 437)	372
Dry Period (days)	115 (75- 155)	151 (72- 173)	190	142 (141- 143)	128 (120- 136)	126 (120-138)	66
Age at First calving (months)	46 (44 -53)	51	45 (44- 46)	53 (49 to 63)	49	46 (43 to 48)	40 (39 to 41)

Source: A.E. Nivsarkar *et al*, (2000), Animal Genetics Resources of India, Cattle and Buffalo, ICAR publication- NDDB (2014).

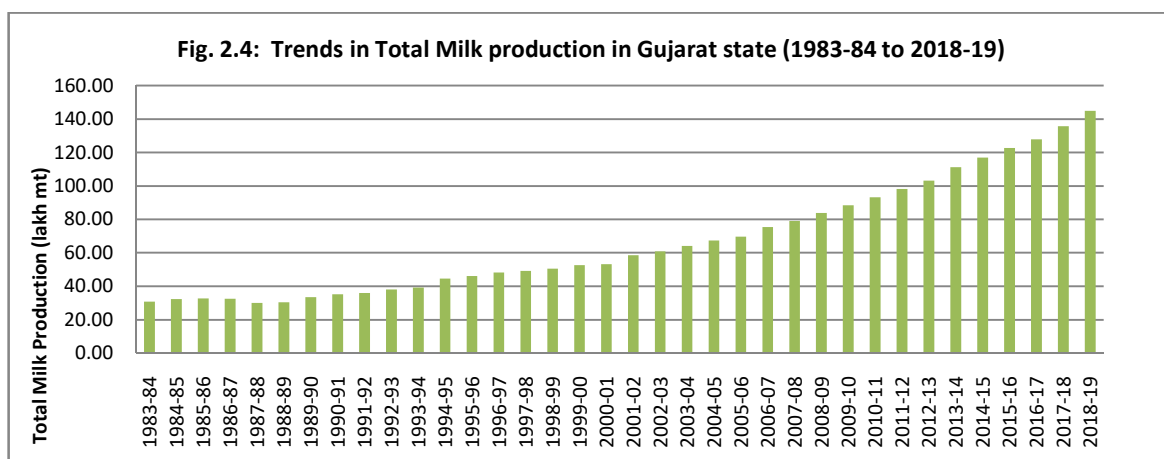
2.4 Growth in Milk Production and Productivity

Gujarat is a leading state in terms of its quality milch animals and milk production. Gujarat ranks third among the milk producing states in India, with 144.93 lakh MT in 2018-19, an increase from the 30.9 lakh tonnes in 1983-84. Various initiatives were taken by the government which helped in improving the milk productivity over the period. A trend showing the increase in milk production in Gujarat over the past three decades is depicted in Fig 2.4. The graph shows a consistent increase in the production of milk over the years. The milk production has increased from 5.32 million tonnes in 2000-2001 to 12.26 million tonnes in 2015-16 registering a growth of 131 per cent over base year. Except for the period of drought from 1986-87 to 1988-89, milk production in the state registered a continuous increase. The milk production declined during 1986-89 due to drought in the state. The rate of increase in milk production was faster than rate of increase in state's human population. As a result, the per capita availability of milk in the state increased from 321 gms/day in 2003-04 to 592 gms/day in 2017-18. Out of total milk production, about 51.07 per cent of the milk production was contributed by indigenous buffaloes followed by 23.88 per cent by crossbreed cattle and 22.70 per cent by indigenous cattle, whereas goats contribute 2.28 per cent to total milk production in 2017-18. The productivity of cows and buffalo in term of daily milk yield is increasing continuously (Fig 2.5 & 2.6). Despite of increase in milk yield, there is still a wide scope for improving milk yield of milch animals.

Table 2.10: Estimated Milk Production in Gujarat: 2000-01 to 2017-18

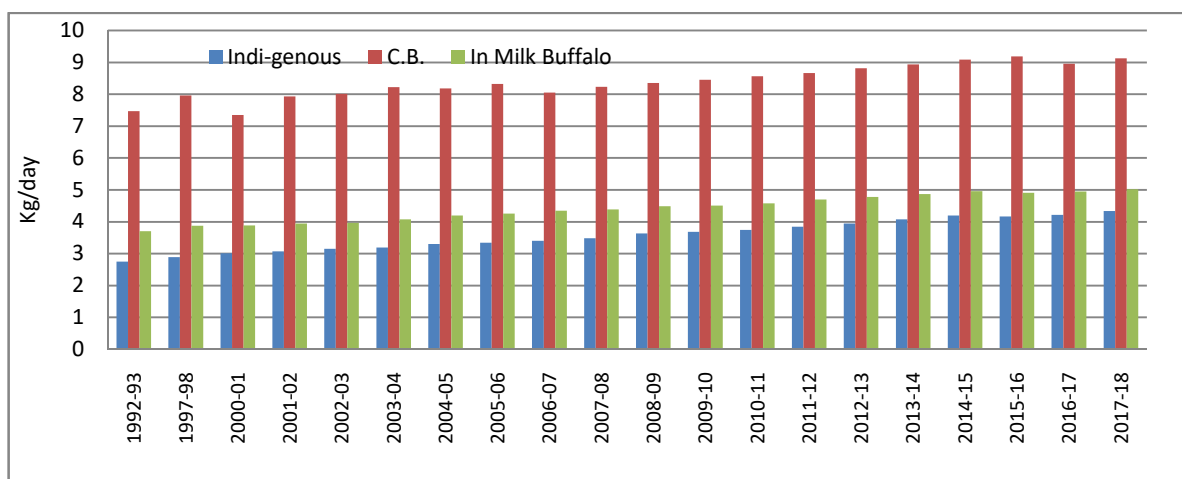
Sr. No	Year	Milk Production in million tones						Growth of Milk Prod(%) over base year	Per Capita availability (gms/day)
		In milk Cow		In Milk Buffalo	In milk Bovine	In Milk Goat	Total		
		Indigenous	C.B.						
1	2000-01	1.43	0.26	3.40	5.09	0.23	5.32	-	-
2	2001-02	1.49	0.36	3.80	5.65	0.23	5.88	10.51	317
3	2002-03	1.58	0.38	3.90	5.86	0.23	6.09	14.52	321
4	2003-04	1.63	0.43	4.12	6.18	0.24	6.42	20.75	330
5	2004-05	1.69	0.48	4.32	6.49	0.26	6.75	26.86	344
6	2005-06	1.74	0.52	4.45	6.70	0.26	6.96	30.89	349
7	2006-07	1.80	0.82	4.66	7.28	0.25	7.53	41.67	372
8	2007-08	1.85	0.96	4.86	7.66	0.25	7.91	48.79	385
9	2008-09	1.85	1.19	5.11	8.15	0.23	8.39	57.73	402
10	2009-10	1.91	1.42	5.28	8.61	0.23	8.84	66.30	418
11	2010-11	1.98	1.59	5.51	9.09	0.24	9.32	75.29	435
12	2011-12	2.06	1.79	5.73	9.58	0.24	9.82	84.61	445
13	2012-13	2.18	2.00	5.90	10.07	0.24	10.31	93.98	476
14	2013-14	2.37	2.30	6.18	10.85	0.26	11.11	108.99	506
15	2014-15	2.52	2.48	6.42	11.42	0.27	11.69	119.86	527
16	2015-16	2.81	2.65	6.51	11.97	0.29	12.26	130.61	545
17	2016-17	2.87	2.93	6.68	12.48	0.31	12.78	140.23	563
18	2017-18	3.08	3.24	6.93	13.25	0.31	13.57	144.55	592

Source: GOG (2017a).



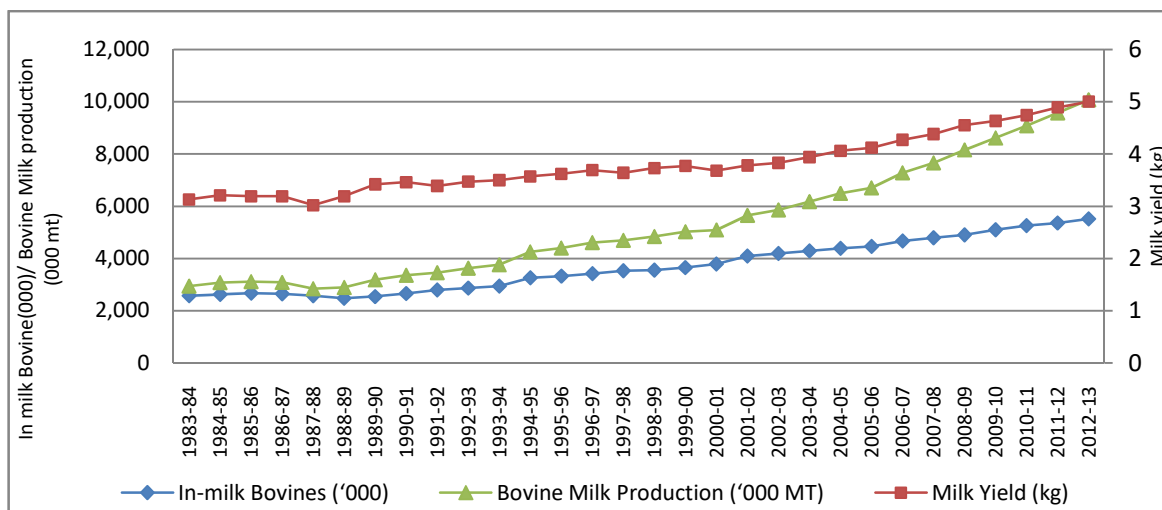
Source: GOG (2017).

Fig. 2.5: Species wise Trends in Total Milk Productivity in Gujarat state



Source: GOG (2017).

Fig. 2.6: Yearwise In milk Bovine Population, Milk Yield and Bovine Milk Production

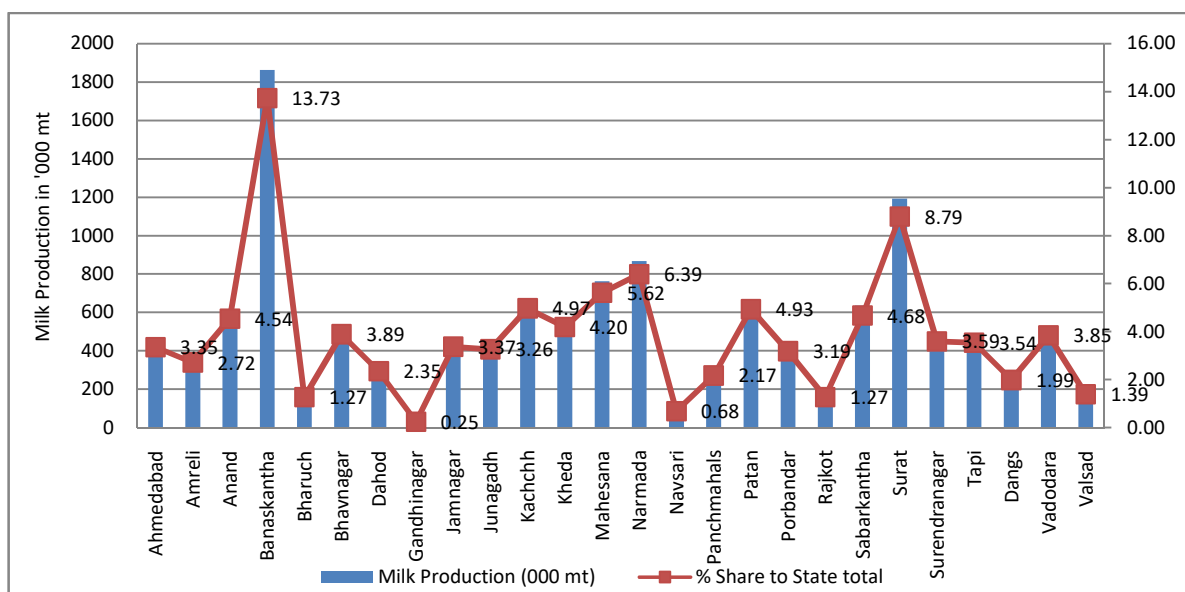


Source: GOG (2017).

Out of total bovine milk production, 55.4 per cent accounted for buffalo milk, 23.5 per cent share accounted for indigenous cows and remaining 22.1 per cent was of cross breed cows. The significant growth in population of in-milk bovine animals supported by increase in milk yield of bovine animals increased bovine milk production by 135 per cent in 2015-16 over 1983-84 (Fig. 2.6). The share of cross breed cows in total milk production increased while share of indigenous cows and buffalo declined during last one and half decade. The corresponding share of cross breed cows, indigenous cows and buffalo was 66.75 per cent, 28.19 per cent and 5.06 per cent respectively in 2000-01.

District-wise milk production in Gujarat state for the year 2017-18 is presented in Fig. 2.7. It can be observed that Banaskantha was the highest milk producing district in the state with an estimated milk production of about 1644 thousand tonnes during 2017-18 accounting more than ten percent of total milk production in the state. Surat is the second largest producer of milk with an estimated share of about 9 percent, followed by Narmada (6.51 %) and Mehsana (5.57%). The top ten districts together contributed about 62 per cent of milk production of the state, including Banaskantha, Sabarkantha, Mehsana, Kheda, Junagadh, Panchmahal, Rajkot, Anand, Kachchh, and Surendranagar. Category-wise share of milk production in Gujarat clearly indicate that top ranked milk producer five districts in Gujarat are dominated by the production of milk by cross breed cows, followed by buffalo and goat (Table 2.11).

Fig. 2.7: District-wise Milk Production in Gujarat (2017-18)



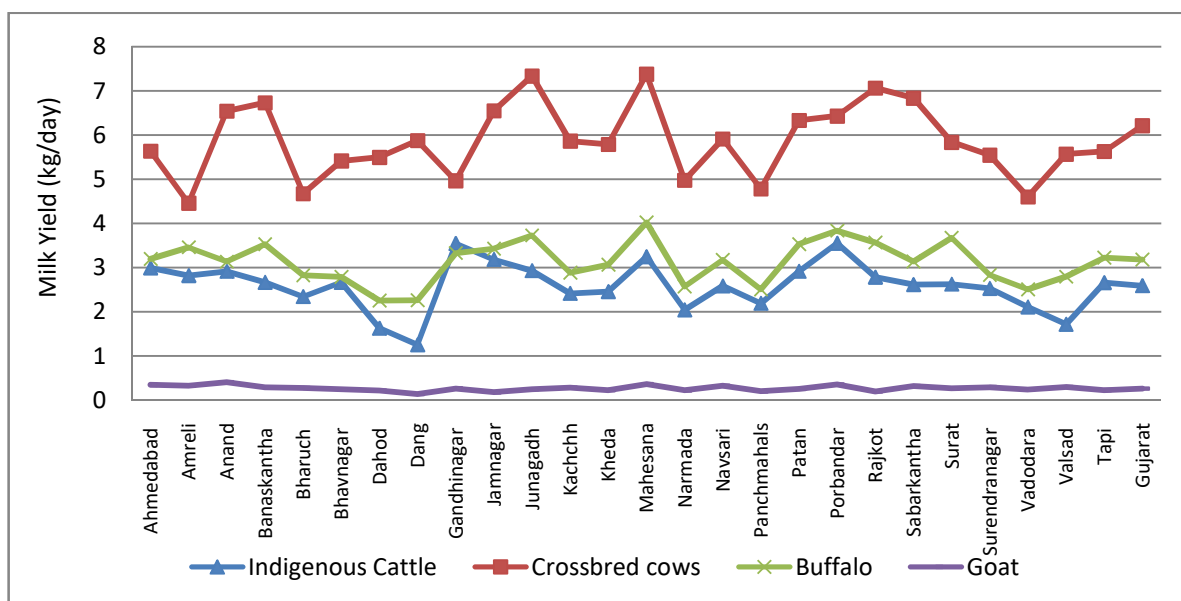
Source: GOG (20 17a), 34th Survey Report.

Table 2.11: District wise & category wise Percentage share of Milk Production in Gujarat

Name of the District	District wise & category wise Percentage share of Milk Production in Gujarat (2016-17)					
	% share of Crossbred Cow	% share of Indigenous Cow	% share of Total Cattle	% share of Buffalo	Goat	% share to total Milk Production
Ahmedabad	0.84	5.00	2.94	3.82	3.35	3.41
Amreli	0.25	4.57	2.43	2.99	4.08	2.76
Anand	6.14	2.49	4.30	4.81	2.88	4.53
Banaskantha	22.47	8.20	15.26	12.34	7.68	13.55
Bharuch	1.05	1.36	1.20	1.28	3.15	1.29
Bhavnagar	0.75	6.62	3.72	4.05	4.64	3.91
Dahod	0.19	3.60	1.91	2.36	9.64	2.33
Dang	0.58	0.23	0.41	0.10	0.38	0.25
Gandhinagar	4.40	1.80	3.08	3.46	1.25	3.24
Jamnagar	0.06	5.88	3.00	3.62	2.57	3.32
Junagadh	1.18	7.36	4.30	5.66	2.80	4.98
Kachchh	0.25	9.06	4.70	3.54	10.53	4.23
Kheda	6.91	2.10	4.48	6.51	3.52	5.52
Mahesana	9.75	2.93	6.31	6.61	3.36	6.39
Narmada	0.14	1.09	0.62	0.63	1.31	0.64
Navsari	6.40	0.51	3.43	1.05	1.74	2.14
Panchmahals	4.05	4.72	4.39	5.43	8.80	5.04
Patan	0.94	2.68	1.82	4.43	2.01	3.19
Porbandar	0.01	1.44	0.73	1.86	0.51	1.31
Rajkot	1.84	7.81	4.85	4.61	2.89	4.68
Sabarkantha	17.44	4.59	10.95	7.19	7.12	8.89
Surat	5.38	2.19	3.77	3.62	2.12	3.65
Surendranagar	0.15	7.20	3.71	3.43	3.54	3.56
Vadodara	1.45	4.41	2.95	4.37	6.33	3.77
Valsad	3.47	1.00	2.22	0.64	2.53	1.40
Tapi	3.92	1.16	2.52	1.61	1.28	2.02

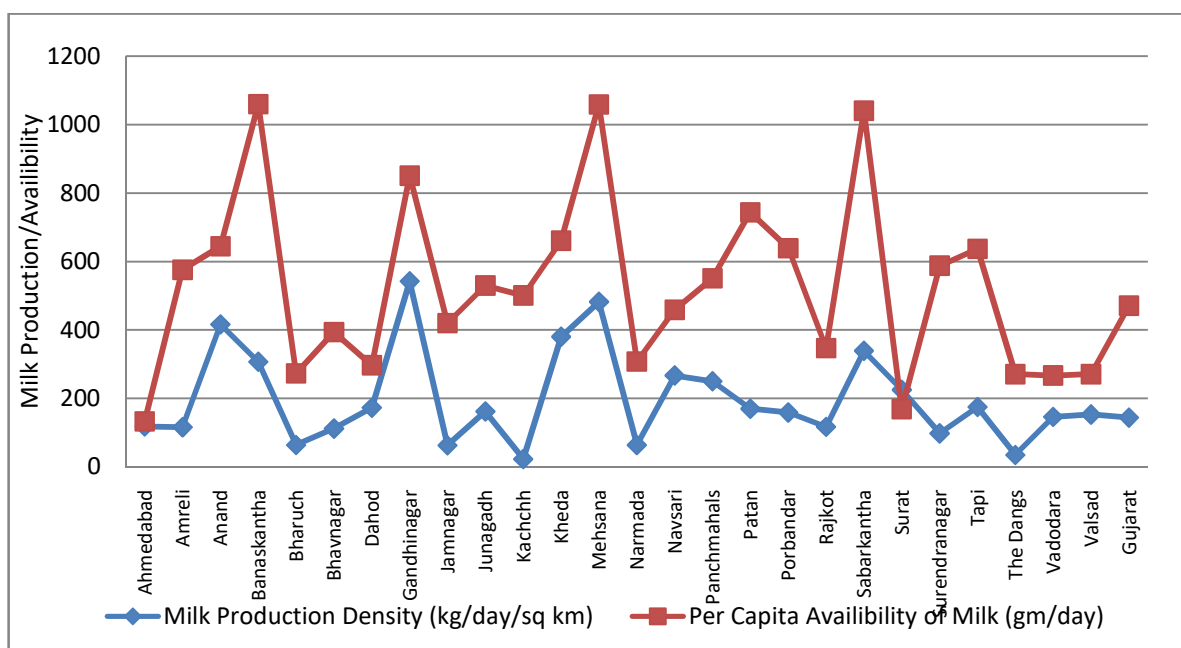
Source: GOG (2015a)

Fig. 2.8: Specieswise District wise total Milk Yield (kg/day) 2016-17



Source: GOG (2017) 34th Survey.

Fig. 2.9: Districtwise Milk Production Density and Per Capita Availability of Milk (2012-13)



Source: NDDB, 2014.

The highest bovine milk yield is recorded in Mehsana district (7.384 kg/day) and the lowest was in Dang district (1.254 kg/day). The species-wise district wise milk yield data presented in Fig 2.8 indicate that among the species, the highest milk yield was recorded in cross breed cows. Among the species, the highest milk yield was recorded in cross breed cows in Mehsana district (7.384 kg/day) and the lowest was in Amreli district (4.459 kg/day). In case of indigenous cows, highest milk yield was recorded in Porbandar (3.55 kg/day) and the lowest was in Dangs (1.254 kg/day).

Mehsana district was the top rank district in case of buffalo yield (4.02 kg/day) while same was recorded lowest in Dahod (2.26 kg/day). The highest milk production density was recorded in Gandhinagar (542 kg/day/sq km), while the highest per capita milk availability was recorded in Banaskantha (1060 gm/day) (Fig. 2.9). However the lowest per capita milk availability was recorded in Ahmedabad (133 gm/day) and the lowest milk production density was recorded in Kachchh (23 kg/day/sq km) which may be due to large area in Kachchh.

2.5 Status of Availability & Requirement of Feed and Fodder in Gujarat

In Gujarat, total reporting area is 188.10 lakh ha. Out of this 99.66 lakh ha (52.98 %) is net sown area while 25.52 lakh ha is barren and uncultivable land. The area under non-agricultural use is 11.71 lakh ha, 19.60 lakh ha is a cultivable waste land. The permanent pasture and other grazing land is 8.51 lakh ha, which is only 4.52 per cent of the total reporting area. The total human population of Gujarat is reported about 604.40 lakh while the collective population of cattle, buffalo, sheep and goat are 233.92 lakh which is about 39 per cent of the human population while their feeding area is only 4.52 per cent. At present, the availability of green forage is estimated to be 608 lakh metric tonnes and dry fodder is 139 lakhs metric tonnes in Gujarat, which shows 25 and 44 percent deficit, respectively. Moreover, decreasing areas under grassland combined with an increasing diversion of crop residues for fuel and industrial uses is creating an acute scarcity of fodder supply not only in Gujarat but in entire India as well. The major fodder crops of Gujarat state by seasons is presented in Box 2.1. The state has three major seasons viz. the hot weather (March to Mid June), *Kharif* (Mid June to September) and *Rabi* (October to February). Considering the rainfall patterns, topography and soil characters, 8 climate zones have been identified in Gujarat state as presented in Table 2.12, along with the dominant fodder crop.

Box 2.1: Major Fodder Crops of Gujarat State

Kharif	Rabi	Summer
<ul style="list-style-type: none"> • Sorghum, Bajra • Maize • Cowpea • Hybrid Napier grass, • Guinea grass, • Clusterbean • Sunflower 	<ul style="list-style-type: none"> • Lucerne, • Oats • Maize • Sunflower • Wild Chicory (Pandadiu) 	<ul style="list-style-type: none"> • Sorghum • Bajra, • Maize, • Cowpea, • Hybrid Napier grass

Table: 2.12: Zonewise Fodder Crops grown in Gujarat

Sr. No.	Geographical area	District	Fodder Crops
1	South Gujarat (Heavy Rainfall)	Dang, parts of Surat and Valsad	Sorghum, Lucerne, Maize, Hybrid Napier, para grass, Guinea grass
2	South Gujarat	Valsad, Parts of Surat, Bharuch and Narmada	Sorghum, Lucerne, Maize, Hybrid Napier, Para grass, Guinea grass & Oat
3	Middle Gujarat	Vadodara, Anand, Kheda, Botad, Chhotaudepur, Panchmahal, Mahisagar	Sorghum, Lucerne, Oat, Hybrid Napier, Maize
4	North Gujarat	Mehsana, Patan, Sabarkantha, Part of Banaskantha	Sorghum (Dual), Hybrid Napier, Maize, Lucerne, Oat and Bajra
5	Bhal Area	Khambhat, part of Bharuch, Hansot (Surat), Matar (Kheda), Dholka, Dhandhuka, Vallbhipur, Limbdi	Sorghum, Maize, Hybrid Naiper, Lucerne, Bajra
6	South Saurashtra	Junagadh, Bhavnagar, Amreli and part of Rajkot	Sorghum (Dual), Maize, Hybrid Naiper, Lucerne, Bajra
7	North Saurashtra	Jamnagar, Rajkot, Perts of Surendranagar and Bhavnagar	Sorghum (Dual), Maize, Hybrid naiper, Lucerne, Bajra
8	North West Zone	Kutch, Ahmadabad, Viramgam, Rajkot, Halvad (Surendranagar) and Part of Banaskantha	Sorghum, Lucerne, Bajra, Oat, Hybrid Napier and Maize

Source: GOG (SAP & SIDP), 2018a.

As such there is lack of time series dataset regarding area under forage and fodder crops in India. While GOG 2018 (SAP & SIDP) report has highlighted the district-wise area under forage crops in Gujarat which was estimated to be 2.32 lakh ha in the year 2017-18 in Gujarat. Out of the total area under forage crops in Gujarat, about one fourth of total area was in Banaskantha district followed by Mehsana having about 10 per cent of total area in the State. Other districts, having around 5 per cent area under forage crop, were Vadodara, Sabarkanta, Kachchh and Kheda (Table 2.13).

It is of prime importance to increase the fodder yield of the state by developing the high yielding and multi-cut type varieties of better quality. It can be accomplished with the help of multi-disciplinary and problem-oriented programme of forage research along with the latest agronomical practices considering low economic costs. The details regarding breeder seed production of forage crops during the decade from 2007-08 to 2016-17 is presented in Table 2.14. However, the yield level of forage crops such as Lucerne, hybrid Napier, Forage Sorghum and Bajra was observed to be lower than potential yield level and thus yield gap existed (Table 2.15). The details on varieties of forage crop suitable for cultivation in Gujarat state are presented in Table 2.16. It is also possible to cover barren area of the state with rainfed grasses.

Table 2.13: Districtwise Area of Forage and Fodder crops in Gujarat

Sr. No.	District	Forage Area (2017-18)		Fodder Area (2017-18)	
		Area 00 ha	% to State total	Area 00 ha	% to State total GCA
1	Ahmadabad	44	1.89	910	14.20
2	Amreli	38	1.64	210	3.32
3	Anand	87	3.75	150	4.90
4	Aravalli	56	2.41	-	
5	Banaskantha	578	24.89	720	6.98
6	Bharuch	19	0.82	100	2.91
7	Bhavnagar	94	4.05	460	6.70
8	Botad	7	0.30	-	
9	Chhotaudepur	9	0.39	-	
10	Dahod	18	0.78	30	0.88
11	Dang	0	0.00	30	5.17
12	Devbhumi Dwarka	8	0.34	-	
13	Gandhinagar	115	4.95	210	9.72
14	Gir Somnath	58	2.50	-	
15	Jamnagar	11	0.47	360	4.77
16	Junagadh	39	1.68	240	3.02
17	Kheda	131	5.64	220	5.16
18	Kachchh	128	5.51	1120	15.91
19	Mahisagar	63	2.71	-	
20	Mehsana	222	9.56	630	13.46
21	Morbi	9	0.39	-	
22	Narmada	6	0.26	30	2.63
23	Navsari	9	0.39	240	14.81
24	Panchmahal	16	0.69	40	1.27
25	Patan	89	3.83	900	18.48
26	Porbandar	52	2.24	80	4.73
27	Rajkot	30	1.29	240	2.70
28	Sabarkantha	118	5.08	270	4.38
29	Surat	32	1.38	260	8.55
30	Surendranagar	59	2.54	770	9.11
31	Tapi	28	1.21	100	5.24
32	Vadodara	131	5.64	180	3.25
33	Valsad	19	0.82	-	0.00
	Total	2322	100.00	8500	6.96

Note: As per DAG, Gujarat published report on 30.04.2018
Source: GOG (2018).

Table 2.14: Breeder Seed Production of Forage Crops (2007-08 to 2016-17)

Production Year	Crop/Variety (Quantity in Q.)			
	Lucerne		Oats (Kent)	Cowpea (GFC-3)
	GAUL-1	AL-3		
2007-08	9.45	0.25	39.10	0.20
2008-09	9.45	0.25	36.70	-
2009-10	17.60	0.25	26.70	-
2010-11	4.25	1.25	18.00	-
2011-12	8.00	3.89	30.00	-
2012-13	4.55	0.57	60.00	-
2013-14	3.00	0.55	75.10	1.00
2014-15	5.00	0.54	75.00	-
2015-16	2.00	0.40	25.00	-
2016-17	4.10	0.85	70.00	-

Source: GOG (2018, SAP).

Table 2.15: Gap Analysis of Forage Crop Yield

Sr. No.	Crop	Green Forage Yield (q/ha)		Gap (%)
		Average Yield	Potential Yield	
1.	Lucerne (Perennial)	1100	1300	18.2
2.	Hybrid Napier (Perennial)	1700	2000	17.6
3.	Forage Sorghum (Single cut)	400	450	12.5
4.	Forage Bajra (Multi-cut)	1150	1500	30.4

Note: Data reported from LSVT trial

Source: GOG (2018, SAP).

Table 2.16: Varieties of Forage Crop

Sr. No.	Name of the Crop	Variety	Year of Release	Green Forage Yield (q/ha)	Recommended Area
1	Lucerne	GAUL-1 (Anand-2)	1975	700-800 in 6-7 cuts	For Gujarat, Rajasthan and Madhya Pradesh
		GUAL-2 (SS-627)	1980	700-800 in 6-7 cuts	For north Gujarat area
		Anand-3	1991	350-400	For cold dry zone of Kinnour Lahaul & Spiti valley of H.P.
		Anand Lucerne-3 (AL-3)	2006	1103 in a year	For whole Gujarat
		Anand Lucerne-4 (AL-4)	2013	500-600 q	North west zone
2	Oats	Kent	1973	500-550	For the whole country
		JO-03-91	2014	500-600	For whole Gujarat
3	Sorghum	C-10-2	1945	300-350	For Saurashtra Region of Gujarat
		S-1049	1955	275-350	For middle Gujarat
		GFS-3	1984	500-550	For the area of North & Middle Gujarat
		GFS-4	1989	360-400	For North Gujarat, South Gujarat, Saurashtra & Kachchh area
		GFSH-1	1992	650-700 in two cuts 400-500 in one cut	For whole Gujarat State except its South part
		GFS-5	1998	400-450	For whole Gujarat State
		CoFS-29 (Endorsed)	2013	400-450	For whole Gujarat State
		GAFS-11	2011	400	Middle Gujarat, Bhal zone and North west zone of Gujarat in rainfed condition
4	Bajra	GFB-1	2005	350-400 in a single cut, 600-800 in multicut	Entire summer forage bajra growing areas of Gujarat State i.e. North & Middle Gujarat
		AFB-3	2011	Av. 460	North west zone of India
		GAFB-4	2018		Middle Gujarat
5	Cowpea	GFC-1	1980	225-250	For whole country
		GFC-2	1980	250	For whole country
		GFC-3	1980	200-250	For whole country
		GFC-4	1980	250-300	For whole country
		EC-4216		280-300	Adapted to the entire country
6	Maize	African tall (composite variety)	1982	400-800	For whole country
7	Hybrid Napier	APBN-1 (Endorsed)	2001	1800-2000 per year	For whole Gujarat State
		Co-3 (Endorsed)	2010	1112.5	For whole Gujarat State
8	Grasses				
	Marvel	GMG 1	1980	250-50 annually	Arid and semi regions of Rajasthan and Gujarat
		GAMG 2	2009	130-240	Pastureland of Gujarat
	Anjan	GAMG 1	2011	214	Rainfed conditions of Gujarat
	Guinea	JHG8-1	2013	1512Q/ha/year	Rainfed conditions of Gujarat

Source: GOG (SAP & SIDP), 2018.

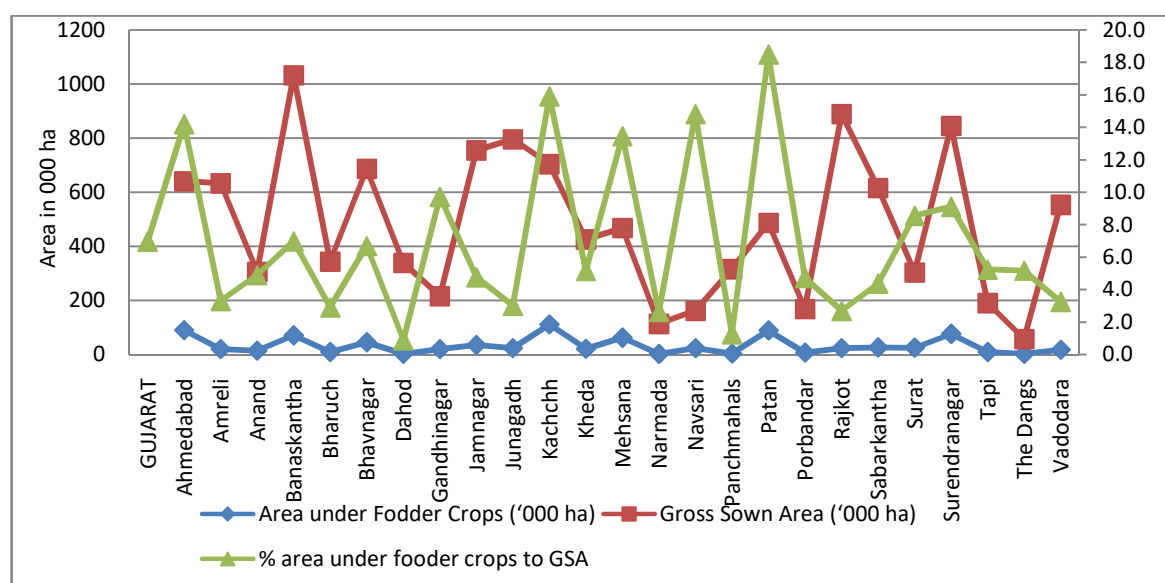
Table 2.17: Feed Nutrients Availability, Requirement & Surplus/Deficit in Gujarat

Year	Feed Nutrients Availability, Requirement and Surplus/Deficit in Gujarat (000 MT)								
	Dry Matter			Crude Protein			Total Digestible Nutrients		
	Availability	Requirement	Deficit/Surplus	Availability	Requirement	Deficit/Surplus	Availability	Requirement	Deficit/Surplus
1992	15,900	-	-	1,682	-	-	8,312	-	-
1997	24,164	34,013	-9,848	3,158	3,023	135	12,925	21,781	-8,856
2003	18,940	44,897	-25,957	2,033	4,027	-1,994	9,562	28,740	-19,77.8
2007	24,517	50,242	-25,726	4,761	4,593	168	14,769	32,082	-17,313
2008	30,710	51,533	-20,824	5,736	4,732	1,005	18,101	32,878	-14,777
2009	26,297	52,991	-26,694	4,625	4,887	-262	14,376	33,786	-19,411
2010	22,586	54,633	-32,046	4,189	5,060	-871	12,303	34,817	-22,514
2011	33,971	56,479	-22,508	6,533	5,252	1,281	20,767	35,985	-15,218

Source: www.indiastat.com

As against the estimated animals' requirements, feed resources available in Gujarat are lower³. During the period 2003 to 2011, shortage of fodder was observed in the state. In context of dry matter, a reduction was observed from 137 per cent of the requirement to 66 per cent; total digestible nutrients from 200 per cent to 73 per cent while the crude protein availability increased from -98 per cent to a surplus of 19 per cent (Table 2.17). Eleven cattle feed factories in the cooperative sector spread across the State, produced about 2.6 million tonnes of concentrated cattle feed for bovines during 2012-13 and was sold at prices ranging from Rs. 11.9 to 14.3 per kg. The usage of concentrate increased from 2.1 kg to 2.7 kg per in-milk cattle, while for buffaloes, it declined from 3.0 kg to 2.7 kg during the same period.

Fig. 2.10: Districtwise Area under Fodder Crops in Gujarat 2007-08



Source: NDDB, 2014.

³ see, Annexure II.

Green fodder is a comparatively economic source of nutrients. However, the availability of green fodder is lower than estimated requirement. In Gujarat, the area under fodder crop has fallen over the last eight years, viz. from 10.47 per cent of the gross sown area in 2000-01 to 6.96 per cent in 2007-08. Figure 2.10 depicts that Patan district had the highest percentage area under fodder crops (18.48%) followed by Kachchh, Navsari, Ahmedabad and Gandhinagar district.

In Gujarat, there is absence of regulated and organized fodder market. Small scale marketing of fodder exists in all rural areas of the state where fodder is sold by producers to traders or directly to the consumers. In rural areas, farmers having surplus fodder sell some quantity to needy cattle owners. Generally, demand for green and dry fodder in a village is met from within village. While green fodder is available from crops like Lucerne, bajra, maize and sorghum, the sources of dry fodder are crop-residues and by-product of cereals and pulses crops. Farmers bring head loads or cartloads of fodder from their fields to the village. Normally, surplus green fodder is sold as standing crop on area basis. Surplus dry straw is sold either in bundles or weight basis in the village to needy cattle owners. Natural grass is abundantly available during September to October when grass is harvested. Generally, grass producers sell their grass soon after the harvest to needy farmers. Grass being a bulky and less remunerative product, producers sell it immediately after harvest.

Box 2.2: Community Fodder Farms in Gujarat

Shah (1989) studied four cases of local collective efforts to improve the management of the *gauchars* (*grasslands used for fodder*)¹ by establishing community fodder farms. All the four case studies were of four villages in the Kheda district of Gujarat. Two of these analyse efforts which succeeded and the benefits that accrued from them to the village community; these attempted to determine the factors that induced success. The other two case studies concentrate on two other villages where community fodder farms failed and the case studies consider various reasons for failure. The two successful efforts (village- Dharmaj and Napad), had several things in common. They were well managed and resulted in manifold increase in the biomass output per acre. They altered the relationship between the resource and the user by introducing a pay to use system, thereby eliminating common property externality that affected the rest of the *gauchars*. Both are economically viable even while selling green fodder at subsidised prices. In contrast, the cases of failure (village- Malataj and Jol) have little in common; one failed due to lack of effective demand and initiative from the community; the other failed primarily due to a corrupt leader. Author suggested that the pay-to-use system creates conditions that mimic a market system and reduce the cost of exclusion. The case studies also offered a tentative hypothesis on the role of leadership in collective action.

2.6 State Govt. Policies for Fodder Development

Now a days, due to increasing burden of human population and fast-paced industrialization, land under fodder cultivation is under pressure. It compels livestock

owners to grow more fodder per unit of land by adopting latest variety of improved fodder seeds having high productivity. So in order to encourage farmers for growing improved varieties of high yielding fodder crops, making them well conversant regarding fodder conservation and its better utilization, improving pastureland, and thereby increase fodder production, State Animal Husbandry Department is running different fodder development schemes for Individual Beneficiaries⁴, as given below:

- Fodder Minikits under Integrated Fodder Development Scheme (Gen. Category)
- Fodder Minikits under Schedule Caste Sub Plan (SCSP)
- Fodder Minikits under Tribal Area Sub Plan(TASP) Scheme
- Cattle Shed subsidy scheme under Integrated Fodder Development Scheme (General Category)
- Cattle Shed subsidy scheme under Schedule Caste Sub Plan(SCSP)
- Assistance for Power Driven Chaff Cutter scheme under Integrated Fodder Development Scheme (General Category)
- Assistance for Power Driven Chaff Cutter scheme under Schedule Caste Sub-Plan (SCSP)
- Assistance for Power Driven Chaff Cutter scheme under Tribal Area SubPlan (TASP)
- Assistance for Silage Bag under Integrated Fodder Development Scheme(General Category)
- Assistance for Silage Bag under Schedule Caste Sub Plan(SCSP)

(a) **Supply of Minikits:** With the aim to provide wide spread publicity and to motivate adoption of better varieties of fodder crops, fodder minikits were distributed for demonstrations to livestock owners through District Panchayat, Intensive Cattle Development Programmes of the state.

(b) **Supply of Power Driven Chaff Cutter:** A subsidy of Rs. 15000/- was given for purchasing Power Driven Chaff Cutter for the better utilization of fodder.

⁴<https://doah.gujarat.gov.in/fodder-development.htm>

- (c) **Fodder Farms:** Department ran six village fodder production farms, which also helped as a demonstration unit to the areas and assured round the year availability of green fodder at a reasonable price for the livestock owners.
- (d) **Establishment of fodder seed production farms:** Fodder crops are always shy seeders. Generally all farmers growing green fodder do not opt for fodder seed production and that creates a short fall between the requirement and availability of fodder seed in general while it caters to the need of fodder seed requirement only to a limited extent. Department has established the fodder seed production farms in different regions of the state. These farms also serve as demonstration to nearby farmers regarding the fodder seed production practices. State Animal Husbandry Department is running two fodder seed production farms. They are each at (i) Mota Jampura, Banaskantha and (ii) Bhutwad, Rajkot.
- (e) **Cattle Shed for Cattle:** Generally it is seen that, poor people lack facility to tie and protect their milch animals due to lack of cattle shed. They are also in need of house for their own family but due to lack of money this facility is not available with them. The poor people keep their milch animals under tree, in the shadow of house or in open space. By keeping milch animals in open space they become vulnerable to cold weather, hot weather and rain. It negatively affects the immune system of milch animals, makes them vulnerable to diseases and compromises on their health thereby reducing milk production. Cattle feed also gets spoiled and fodder wastages rise up to 20% and more, resulting in an increase in milk production cost. To overcome above mentioned difficulties in dairy husbandry faced by Scheduled Caste and other general category households, implementation of assistance scheme for cattle shed, feeding trough, water tank and 7 litre steel bucket was started. 50% assistance of expenditure or 18,000/- for 2 animals, 50% assistance of expenditure or 63,000/- for 5 animals, 50% assistance of expenditure or 1,25,000/- for 10 animals maximum can be given under this scheme to the households.

(f) Centrally Sponsored Fodder Development Schemes: The main objective of this scheme is to take steps for improvement in production of protein rich feed and fodder for livestock and to improve quality of feed and fodder for livestock in the country.

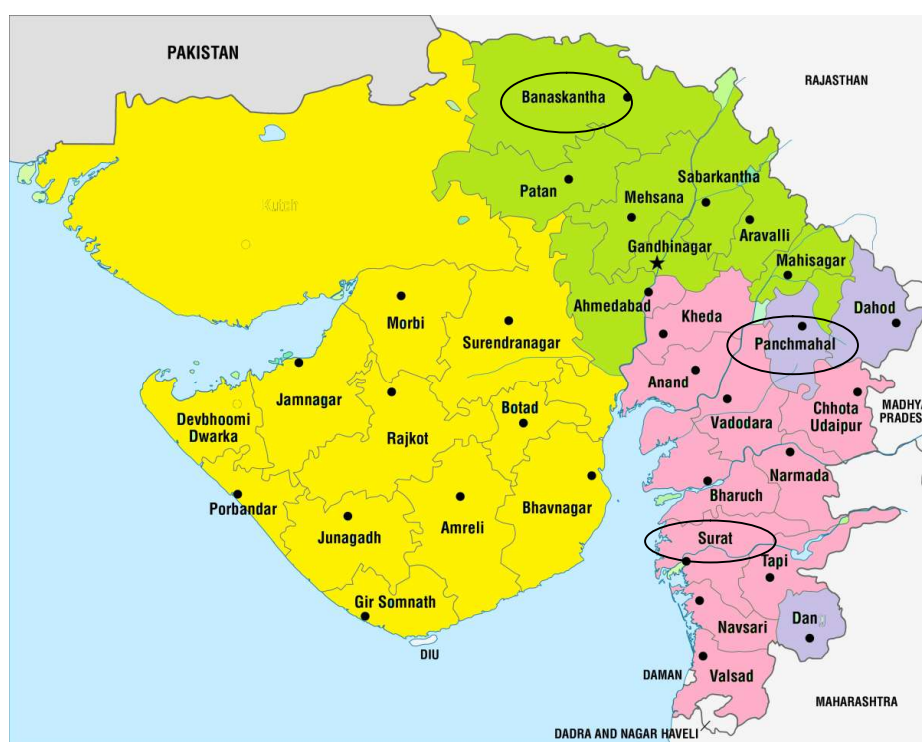
The socioeconomic profiles of the selected households are discussed in next chapter.

Socio-Economic Characteristics of Sample Households

3.1 About Study Area:

Gujarat has varying topographic features though a major part of the state was dominated by parched and dry region. The average rainfall in the state varies widely from 250 mm to 1500 mm across various zones. Out of 8 agro-climatic zones, five are arid to semi-arid in nature, while remaining three are dry sub-humid in nature. As per the sampling framework, three districts were selected from three regions of the state (see, Map 5.1), i.e. Banaskanatha (North Gujarat), Surat (South Gujarat), and Panchmahal (East Gujarat). The socioeconomic profiles of the selected households are discussed in this chapter.

Map 3.1: Selected districts in Agrarian Socio-Ecologies of Gujarat



3.2 Profile of Selected Households

The various socio-economic factors for instance size of family, education and training of dairy producer, availability of land and off farm income, experience in dairy, etc have direct influence on dairy farmers' decision to whether

they want to expand and improve their dairy operations. The socio-economic characteristics of selected sample households are presented in Table 3.1. It can be seen from this table that the average age of the selected household head/respondent was around 46 years of which almost half of them found to be illiterate. The remaining half of the household respondents were educated mostly up to the highest level of high schools except few of them were found graduated. Out of the total selected respondents, almost 46 per cent were from backward classes, followed by around 28 per cent from Scheduled Caste, 14 per cent from Schedules Tribe and rest of them belongs to open category. Most of the selected households respondents were male (92 per cent) and very few (8 per cent) were female respondents.

The selected households had relatively higher experience in dairy business (20 years) followed by farming (18 years) and sheep and goat rearing (10 years). The average family size was found to be 6.66 persons and the highest share of family members were found to be primarily engaged in dairy business (44 per cent) followed by 36 per cent in farming and rest of them were in sheet and goat farming. The main occupation of the selected households was agriculture comprised of cultivation of land as a farmer along with supportive allied activity of animal husbandry and dairying. Agriculture was the primary occupation of 55 per cent households followed by animal husbandry and dairy (22 per cent) and around 12 per cent were depends on labour activities. Own farm establishment and self employment were other major sources of occupation. The annual average income of the selected households was estimated to be Rs. 105756/- followed by Rs. 78705/- from dairy, Rs 6610/- from sheep and goat rearing. Around 73 per cent of the selected households were found be a member of social and cooperative organisations.

Table 3.1: General Characteristics of the Sample Households

Sl. No	Particulars	Number / Percentage	
1	Average age of the sample households (years)	46.07	
2	Education level (%)		
	Illiterate	48.5	
	Primary (1 to 4)	17.9	
	Middle School (5 to 8)	16.5	
	High School (9-12)	15.1	
	Graduate	1.4	
	Post Graduate & above	0.7	
3	Caste (%)		
	General	12.71	
	OBC	45.36	
	SC	13.75	
	ST	28.18	
4	Gender (%)		
	Male	92.44	
	Female	7.56	
5	Average Experience (Years)		
	Farming	17.71	
	Dairying	19.62	
	Sheep & Goat rearing	10.03	
6	Average family Size (No.)	6.66	
7	Average Income (Rs)		
	a) Agriculture	105756	
	b) Dairy	78705	
	c) Sheep & Goat farming	6610	
	d) Other	33753	
8	Average No. of family members engaged		
	Farming	36.40	
	Dairying	43.69	
	Sheep & Goat rearing	19.91	
9	Occupation	Primary	Secondary
	Agriculture	54.98	9.97
	Animal Husbandry & dairy	21.65	70.45
	Agri Labour	12.37	6.53
	Non- Farm labour	1.03	0.69
	Trade	1.37	0.00
	Employee	0.00	0.00
	Other (Specify)	8.59	12.37
10	Member of Social & Cooperative Organization (%)	Yes	No
		72.51	27.49

Source: Field Survey data.

3.3 Chapter Summary

The chapter presented the profile of the selected households. The varying topographic features of Gujarat justify the selection of three districts from three regions, i.e. Banaskantha (North Gujarat), Surath (South Gujarat), and Panchmahal (East/Central Gujarat). The average age of the selected household head/respondent was around 46 years of which almost half of them found to be illiterate. Out of the total selected respondents, almost 46 per cent were from backward classes, followed by around 28 per cent from Scheduled Caste, 14 per cent from Schedules Tribe and rest of them belongs to open category. Most of the selected households respondents were male (92 per cent) and very few (8 per cent) were female respondents. The selected households had relatively higher experience in dairy business (20 years) followed by farming (18 years) and sheep and goat rearing (10 years). The average family size was found to be 6.66 persons and the highest share of family members were found to be primarily engaged in dairy business (44 per cent) followed by 36 per cent in farming and rest of them were in sheet and goat farming. The main occupation of the selected households was agriculture comprised of cultivation of land as a farmer along with supportive allied activity of animal husbandry and dairying. Agriculture was the primary occupation of 55 per cent households followed by animal husbandry and dairy (22 per cent) and around 12 per cent were depends on labour activities. Own farm establishment and self employment were other major sources of occupation. The annual average income of the selected households was estimated to be Rs. 105756/- followed by Rs. 78705/- from dairy, Rs 6610/- from sheep and goat rearing. Around 73 per cent of the selected households were found be a member of social and cooperative organisations.

The next chapter presents estimation of area, production & productivity of fodder & feed crops by sample households.

Estimation of Area, Production & Productivity of Fodder & Feed crops by Sample Households

4.1 Introduction:

After having discussed about the selected study area and characteristics of the sample households, this chapter discusses the data on land use pattern, cropping pattern, details on feed and fodder fed to animals, availability of sheds and fodder storages and returns from livestock rearing by selected households.

4.2 Land Use Patterns

The land use pattern of the selected households is presented in Table 4.1. It can be seen from the table that on an average operational land holdings was estimated to be marginal size of holdings having 0.91 ha of which 92 per cent land was irrigated. It was very surprising and pleasant to note that almost 44 per cent of total operational holdings was devoted to fodder crops, while same was very significant in case of land under rainfed condition (72 per cent) as compared to 42 per cent land was under fodder by irrigated land holders. The groundwater the main source of irrigation followed by surface sources such as canal and tank.

Table 4.1: Landholding and Sources of irrigation

Sl.No	Particulars	Irrigated	Un-irrigated	Total
1	Owned Land (ha)	0.79	0.07	0.86
2	Leased in Land (ha)	0.04	0.01	0.06
3	Leased out Land (ha)	0.00	0.00	0.00
4	Uncultivated land (ha)	0.00	0.00	0.00
5	Net operated area (ha)	0.84	0.07	0.91
6	Area under Fodder crop (ha)	0.35	0.05	0.40
7	Village Agro forestry (ha)	0.00	0.00	0.00
8	Village Grazing land (ha)	0.00	0.00	0.00
9	Other (specify)	0.00	0.00	0.00
10	Source of irrigation (%)			
	Canal		6.43	
	Bore well		56.73	
	Dug well		5.85	
	Tank		4.68	
	Other		5.26	
	Multiple sources (canal & well)		20.47	
	Multiple sources (tank and other)		0.58	

Source: Field survey data.

4.3 Cropping Pattern

The cropping pattern of the selected households presented in Table 4.2a indicates that highest area under fodder crops was recorded during kharif and rabi season. Besides, during kharif seasons, supportive crops which by product can be used as fodder crops such as maize, bajra, moong, urad and groundnut were grown. Table 4.2b indicates that fodder cultivation is found to be relatively less profitable than other crops.

Table 4.2a: Cropping Pattern of the Selected Households

Name of Crop	Area (ha)	Production (Qtl/ha)		Total cost (Rs.)	Total return (Rs.)
		Main Product	By-product		
Kharif					
Paddy	21.29	468.00	252.35	371700	798850
Bajra	43.41	550.80	2037.10	1004700	1831530
Maize	20.98	369.10	193.50	340040	758000
Tur	0.84	3.00	1.50	10000	18500
Moong	0.24	5.00	0.00	2500	3500
Urad	0.24	2.00	0.80	4000	10000
Groundnut	40.77	501.64	942.00	1773450	2578627
Sesamum	1.92	11.40	0.00	51650	66750
Castorseed	16.49	264.90	0.00	326300	1199750
Cotton	17.69	254.60	53.00	653000	1115700
Fodder	66.85	5204.90	0.00	982175	1935370
Vegetables	4.92	112.00	4.00	145000	251000
Guar	11.33	64.05	52.40	161750	353575
Marigold	0.48			35000	50000
Sub-total	247.43	7811.39	3536.65	5883765	10992652
Rabi					
Wheat	30.46	683.30	1147.70	971000	1763440
Bajra	1.08	22.50		15000	44000
Maize	18.47	357.30	167.05	317600	686000
Gram	0.60	7.50	2.50	5000	26000
Mustard	55.34	642.90	0.00	1718402	2707252
Castorseed	4.80	42.80	0.00	101000	178650
Dill Seed	0.24	3.40	0.00	12000	23800
Tobacco	0.48	4.80	0.00	22600	23040
Cumin	19.72	101.00	0.00	856000	1611400
Saunf	0.24	6.00	0.00	14000	39000
fodder	29.14	3830.00	0.00	614650	1032710
Guar	3.36	20.00		50000	80000
Vegetables	9.83	1018.00	83.00	512500	882000
Sub-total	173.74	6739.50	1400.25	5209752	9097292
Summer					
Bajra	59.83	1142.00	2925.50	1325950	3375965
Groundnut	0.72	8.40	3.00	16500	35000
Fodder	23.20	2726.00	0.00	417440	713900
Sub-total	83.75	3876.40	2928.50	1759890	4124865
Grand Total	18427.29	7865.40	12853407.00	24214809.00	18427.29

Table 4.2b: Cost of Cultivation, Returns and Profit realised by Selected Households

Name of crop	Cost of Cultivation (Rs. /ha)	Total returns (Rs. /ha)	Profit (Rs./ha)	Yield (qtls/ha)
Kharif				
Paddy	17454.8	37513.6	20058.7	22.0
Bajra	23147.0	42196.0	19049.1	12.7
Maize	16205.3	36124.1	19918.8	17.6
Tur	11914.3	22041.4	10127.1	3.6
Moong	10425.0	14595.0	4170.0	20.9
Urad	16680.0	41700.0	25020.0	8.3
Groundnut	43501.7	63252.2	19750.5	12.3
Sesamum	26922.6	34793.4	7870.9	5.9
Castorseed	19791.6	72770.3	52978.7	16.1
Cotton	36922.2	63084.3	26162.2	14.4
Fodder	14693.0	28952.4	14259.5	77.9
Vegetables	29495.1	51057.1	21562.0	22.8
Guar	14275.1	31204.4	16929.3	5.7
Marigold	72975.0	104250.0	31275.0	0.0
Sub-total	23779.1	44426.6	20647.5	31.6
Rabi				
Wheat	31882.4	57901.9	26019.5	22.4
Bajra	13900.0	40773.3	26873.3	20.9
Maize	17199.9	37150.9	19951.0	19.3
Gram	8340.0	43368.0	35028.0	12.5
Mustard	31054.1	48924.1	17870.0	11.6
Castorseed	21058.5	37248.5	16190.0	8.9
Dill Seed	50040.0	99246.0	49206.0	14.2
Tobacco	47121.0	48038.4	917.4	10.0
Cumin	43398.4	81696.5	38298.1	5.1
Saunf/Funnel	58380.0	162630.0	104250.0	25.0
Fodder	21095.4	35443.6	14348.2	131.4
Guar	14892.9	23828.6	8935.7	6.0
Vegetables	52125.0	89705.9	37580.9	103.5
Sub-total	29985.7	52361.2	22375.5	38.8
Summer				
Bajra	22161.2	56423.9	34262.8	19.1
Groundnut	22935.0	48650.0	25715.0	11.7
Fodder	17992.0	30769.6	12777.7	117.5
Sub-total	21012.9	49250.4	28237.5	46.3
Grand Total	25455.9	47956.9	22501.0	-

Source: Field survey data.

4.4 Details of Value of Animals

The details on fodder and feed fed to the animals are presented in Table 4.3. It can be seen from the table that Banaskantha district dominates the selection of sample households because as per Livestock Census 2012, Banaskantha district (9.38 %) had

the highest number of livestock population in the State followed by Panchmahal (7.41%), Kachchh (7.14%) while Surat has 2.4 per cent livestock population of the state. Besides, Banaskantha had the highest number of in-milk buffaloes and cows followed by Sabarkantha and Mehsana district. Thus selected three districts represents the three divisions of the state viz. North, Central and South region of Gujarat.

Table 4.3: District wise Classification of Animals of the sample households

Sr. No.	District	Selected HH			ALL HH	
		B	C	SG	T	(Multiple)
1	Banaskantha	118	102	54	274	160
2	Panchmahal	54	48	63	165	89
3	Surat	16	17	16	49	42
	Grand Total	188	167	133	488	291

Source: Field survey data.

Table 4.4: Classification of Animals of the Sample households based on their Age

Sr. No.		Banaskantha	Panchmahal	Surat	Grand Total	% to Total
1	Buffalo					
	>1 year	0	00	31	31	6.2
	1-2 Year	01	01	01	03	0.6
	< 2 Years	299	110	54	463	93.2
	Total	300	111	86	497	100.0
2	Crossbred Cattle					
	>1 year	0	0	12	12	4.5
	1-2 Year		3	2	5	1.9
	< 2 Years	158	63	28	249	93.6
	Total	158	66	42	266	100.0
3	Indigenous cattle					
	>1 year	0	0	07	07	4.0
	1-2 Year	01	0	03	04	2.3
	< 2 Years	89	58	17	164	93.7
	Total	90	58	27	175	100.0
4	Sheep					
	>1 year	104	31	10	145	19.5
	1-2 Year	273	04	02	279	37.6
	< 2 Years	296	16	06	318	42.9
	Total	673	51	18	742	100.0
5	Goat					
	>1 year	167	128	90	385	27.5
	1-2 Year	228	66	74	368	26.3
	< 2 Years	376	197	73	646	46.2
	Total	771	391	237	1399	100.0

Source: Field survey data.

It can be seen from the Table 4.4 that the more than 93 per cent selected buffalo and Cattle had average age of more than 2 years while around two fifth of sheep and goats were of same age. The average value of sheep and goat for the age of 2 years and above ranges between as high as around Rs. 6821/- and Rs. 6593/- in

Banaskantha and as lowest as Rs. 1020/- in Panchmahal district and Rs. 1873 in Surat district, respectively.

Table 4.5: Average value of Sheep and goat based on their age (Rs)

Sr. No.	Age Group	Banaskantha	Panchmahal	Surat	Av.
1	Sheep				
	>1 year	3947	613	1000	3031
	1-2 Year	5233	2000	7500	5203
	< 2 Years	6821	1563	3333	6491
	Grand Total	5733	1020	2500	5330
2	Goat				
	>1 year	3617	291	1122	1928
	1-2 Year	4649	3382	2209	3931
	< 2 Years	6593	2939	2459	5011
	Grand Total	5374	2147	1873	3879

It can be seen from the Table 4.6 that the average value of the buffalo, crossbred cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 48000/- , followed by Rs. 39000/- for crossbred cattle and Rs. 30000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Banasskantha and Panchamal district than Surat. The average value of animals as per stage of life i.e. heifer not pregnant, heifer pregnant, dry and mulching animals.

Table 4.6: Average Value of the Buffalo, Cross breed & Indigenous Cattle (Rs)

Sr. No.	Age Group	Banaskantha	Panchmahal	Surat	Av.
1	Buffalo				
	>1 year	0	0	15645	15645
	1-2 Year	30000	30000	25000	28333
	< 2 Years	50077	50691	43278	49430
	Total	50010	50505	33105	47195
2	Crossbred Cattle				
	>1 year	0	0	12250	12250
	1-2 Year	0	13333	27500	19000
	< 2 Years	43101	35897	38929	40809
	Total	43101	34871	30762	39111
3	Indigenous cattle				
	>1 year	0	0	28857	28857
	1-2 Year	25000	0	22000	22750
	< 2 Years	28831	28431	39118	29756
	Total	28789	28431	34556	29560

Table 4.7: Average Value of the Buffalo, Cross breed & Indigenous Cattle (Rs)

Sr. No.	Age Group	Banaskantha	Panchamahahal	Surat	Av.
1	Buffalo				
	Milching	48675	52241	57235	50416
	Dry	54933	50563	18600	50624
	Heifer Pregnant	42800	65000	33000	42056
	Heifer non-pregnant	-	30000	26000	27500
2	Crossbred Cattle				
	Milching	43388	36564	43947	41961
	Dry	43313	35978	18333	39112
	Heifer Pregnant	34800	-	33333	34000
	Heifer non-pregnant	-	8000		8000
3	Indigenous cattle				
	Milching	30579	29075	46154	31760
	Dry	28325	-	17500	27810
	Heifer Pregnant	24636	34000	-	26077
	Heifer non-pregnant	-	13333	15000	14000

4.5 Details of Fodder & Feed fed to Animals

There is a direct relation between the nutritional status of the animals and the type of feed fed. For getting the best results, feeding of animal need planned scientific, practical as well as economical approach. Livestock feeds are generally classified as roughages and concentrates. Roughages are further classified into green fodder and dry fodder. Green fodder are cultivated and harvested for feeding the animals in the form of forage (cut green and fed fresh), silage (preserved under anaerobic condition) and hay (dehydrated green fodder). Fodder production and its utilization depend on various factors like cropping pattern followed, climatic condition of the area as well as the socio-economic conditions of the household and type of livestock reared. The cattle and buffaloes are normally fed on the fodder available from cultivated areas, supplemented to a small extent by harvested grasses. The major sources of fodder supply are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands.

4.5.1 Fed to Buffaloes

The details on the fodder and feed fed to the buffaloes are presented in Table 4.8. It can be seen from the table that the average feed and fodder consumption was about 16 kg of green of fodder followed by 14 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed to the adult animals. The quantity of feed and fodder fed to the animals were significantly high for milch animals

followed by the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day.

Table 4.8: Average Feed and Fodder requirement for Buffalo (per day per animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	
Milching	15.8	3.1	14.5	5.3	2.8	20.0	1.9	22.9	4.53
Dry	15.8	3.0	14.0	5.4	2.0	20.0			4.00
Heifer Pregnant	15.4	3.1	14.2	4.9	2.8	20.0	1.2	24.2	3.80
Heifer non-pregnant	15.5	1.9	10.9	3.8					4.50
<1 year	14.3	1.1	10.1	2.1					4.72
1-2 Year	12.0	1.8	13.7	5.3					

4.5.2 Fed to Cross Bred Cattle

The details on the fodder and feed fed to the cross bred cows are presented in Table 4.9. It can be seen from the table that the average feed and fodder consumption by milching and heifer pregnant was about 15 kg of green of fodder followed by 13 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed. The quantity of feed and fodder fed to the animals were slightly high for milch animals followed by the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day.

Table 4.9: Average feed and Fodder requirement for Cross Breed Cattle (per day per animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	
Milching	15.19	2.92	13.79	5.34	2.95	21.26	1.82	21.36	
Dry	14.74	3.03	12.91	5.54	4.50	24.00			
Heifer Pregnant	15.91	2.95	14.36	4.27	2.00	22.00			
Heifer non-pregnant	10.00	2.50	15.00	6.00	3.00	24.00			
<1 year	15.82	2.41	11.11	3.89	4.00	23.33			
1-2 Year	15.80	2.30	10.00	5.50					

4.5.3 Fed to Indigenous Cattle

The details on the fodder and feed fed to the local cows are presented in Table 4.10. It can be seen from the table that the average feed and fodder consumption by all animals was about 14-15 kg of green of fodder followed by 11-13 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed. The quantity of feed and fodder fed to the animals were slightly high for milch animals followed by

the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day.

Table 4.10: Average feed and Fodder requirement for Indigenous Cattle (per day per animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	
Milching	13.79	2.88	11.86	4.77	3.37	22.27	1.38	21.59	4.8
Dry	13.57	3.29	13.48	4.62	2.43	21.71	0.25	25.00	4.0
Heifer Pregnant	14.46	3.27	14.23	4.54	3.00	23.00			4.8
Heifer non-pregnant	15.00	2.30	11.60	4.60	2.33	23.33			4.0
<1 year	14.86	2.29	10.00	3.33	2.00	23.00			4.0
1-2 Year	14.50	2.50	11.25	4.75					4.0

4.5.4 Fed to Sheep & Goats

The details on the fodder and feed fed to the local cows are presented in Table 4.11 & 4.12. It can be seen from the table that these animal were mostly fed outside by taking out for grazing and very few of the households had fed them with the dry fodder and some concentrates. On an average, animals were also taken out for grazing for 7-8 hours on each day.

Table 4.11: Average feed and Fodder requirement for Sheep (per day per animal)

Particulars	Gender	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
		Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	
<1 year	Male									7.3
	Female			1.0	5					7.6
1-2 Year	Male									7.8
	Female					0.5	20			7.9
>2 Years	Male			1	4					
	Female									7.9

Table 4.12: Average feed and Fodder requirement for Goat (per day per animal)

Particulars	Gender	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
		Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	Quantity (Kg)	Price (Rs/Qtl)	
<1 year	Male	0.6	1.8	0.4	4.0	0.2	21.0	0.6	1.8	7.64
	Female	0.5	1.8	0.3	4.0	0.2	20.9	0.5	1.8	7.27
1-2 Year	Male									7.38
	Female	0.4	1.5					0.4	1.5	7.31
>2 Years	Male	0.6	1.9	0.4	3.3	0.2	21.4	0.6	1.9	7.45
	Female									7.42

4.6 Feed and Fodder requirement as per NATP standard:

The total requirement of feed and fodder presented in Table 4.13 is estimated using the standards given by the NATP database and as per the available data of livestock census of 2012. It can be seen from the table that total green fodder requirement of livestock in the state as per Livestock Census 2012 is estimated to be 85062 tonnes, 415411 tones of dry fodder and 289746 tones of concentrates.

Table 4.13: Total Feed and Fodder requirement as per the NATP Standards in Gujarat

Animal category	Number of animals*	Green Fodder		Dry Fodder(Kg)		Concentrates(Kg)	
		(Kg per animal/day)	Total (Kg)	(Kg per animal/day)	Total (Kg)	(Kg per animal/day)	Total (Kg)
CB	1926703		6624941		29187541		15310947
In-milk	732208	4.75	3477988	5.5	19128934	0.64	12242518
Dry & not Calve once	316255	3.4	1075267	4.02	4322573	0.4	1729029
Adult male	83576	4.06	339319	6.03	2046091	0.33	675210
Young stock	794664	2.18	1732368	2.13	3689943	0.18	664190
Indigenous	8057250		28257516		160306531		98402636
In-milk	1910247	4.75	9073673	6.34	57527088	1.05	60403443
Dry	1182235	3.4	4019599	4.95	19897015	0.52	10346448
Adult male	2309069	4.06	9374820	7.47	70029906	0.36	25210766
Young stock	2655699	2.18	5789424	2.22	12852521	0.19	2441979
Buffalo	10385574		43081543		223088582		175244957
In-milk	3534030	5.96	21062819	6.34	133538271	1.05	140215185
Dry	1544788	5.44	8403647	4.95	41598051	0.52	21630987
Adult male	835775	4.04	3376531	7.47	25222687	0.36	9080167
Young stock	4470981	2.29	10238546	2.22	22729573	0.19	4318619
Goat	4958972	1.04	5157331	0.2	1031466	0.06	61888
Sheep	1707750	1.01	1724828	0.2	344966	0.04	13799
Others	91951	2.35	216085	6.72	1452090	0.49	711524
Total per day	27128200		85062244		90506878		9776496
Per year in tonnes			31047719		33035010		3568421

Note: as per 19th livestock census data

Table 4.14: Green Fodder yields for Land Use Classification

Sl. No	Land use category	Green fodder (tones/ha/year)	Total Area(ha)	Total Availability
A	Area under fodder crop	40.93	1426500	58386645
B	Forest area and on assumption that only 50% area was accessible for grazing	3.00 (1.50 if considered whole forest area)	2108000	6324000
C	Permanent pastures and other grazing lands	5.00	801800	4009000
D	Cultivable wastelands	1.00	1929800	1929800
E	Current fallows	1.00	587200	587200
F	Other fallows	1.00	35000	35000
G	Misc. Tree Crops and Groves not Included in Net Area Sown	1.00	5400	5400
	Total			71277045

Source: FAO (2012), Ramachandra et al, 2007.

With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data of the State of Gujarat for the year 2016-17 and presented in Table 4.14. It can be seen from the table that total availability of green fodder was estimated to be 71277 thousand tonnes.

The crop residues of various crops form a portion of dry fodder consumed by livestock and the quantum of available crop residues is often unable to be estimated directly, as it is seldom quantified. The crop residues, oil cakes, brans and chunnies of various fodder related crops are estimated by the conversion formulations and presented in Table 4.15. It can be seen from the table that main crops residues available for livestock in the state are Bajra, Paddy, Wheat, Pulses, Oilseeds and Sugarcane.

Table 4.15: Crop Residues of Various Crops in terms of Harvest Indices and Extraction Rates

Sl. No	Crop	Conversion Factors in terms of Harvest Indices and Extraction Rates used in the calculation of Feed resources such as crop residues oil cakes grains								
		Number of Acres in the State	Harvest indices (HI)*				Extraction Rate(ER)			
			Crop residues*	Total	Oil Cakes*	Total	Grains*	Total	Brans and Chunnies*	Total
1	Paddy	1988473	1.3	2585015	-	-	0.02	39769	0.08	159078
2	Wheat	2757755	1	2757755	-	-	0.02	55155	0.08	220620
3	Sorghum	163193	2.5	407983	-	-	0.05	8160	-	0
4	Bajra/Pearl millet	911631	2.5	2279078	-	-	0.05	45582	-	0
5	Barley	NA	1.3	-	-	-	0.1	0	-	0
6	Maize	840659	2.5	2101648	-	-	0.1	84066	-	0
7	Ragi	24000	2	48000	-	-	0.05	1200	-	0
8	Small Millets	21024	2.5	52560	-	-	0.1	2102	-	0
9	Other cereals	3465	2	6930	-	-	0.1	347	-	0
10	Pulses	834931	1.7	1419383	-	-	-	0	0.03	25048
11	Ground nut	2874389	2	5748778	0.7	2012072	-	0	-	0
12	Oilseeds	4546691		0	0.7	3182684	-	0	-	0
13	Sugarcane	10799533	0.25	2699883	-	-	-	-	-	-
	Total	25765744		20107011	-	5194756	-	236381	-	404746

Notes:* includes cultivated fodder and the fodder gleaned and gathered from cultivated and uncultivated lands; Estimation as per NATP project database factor and Crop Production Data

Source: GOG (<https://dag.gujarat.gov.in/estimate.htm>).

The percent gap between the requirement and availability has been computed and presented in Table 4.16. It can be seen from the table that State is deficit in dry fodder followed by availability of concentrates. The green fodder availability is in excess by almost 30 percent than requirement.

The major sources of livestock feed reported by the sample households are presented in Table 4.17 which indicate that crop residues was major source of the livestock feed followed by grazing land. Half of the respondents depend on the

improved forage and pastures, household left over and tree legumes grown as hedge. Very few household have reported use of feed preserved feed in storages.

Table 4.16: Difference between Total Feed and Fodder available and required in the State

State	Total Feed and Fodder available and required in the State			
	Required	Available	Difference	GAP
Green fodder	31047719	71277045	-40229326	-129.57
Dry fodder	33035010	25301767	7733243	23.41
Concentrates	3568421	641127	2927294	82.03

Table 4.17: Major Sources of Livestock Feed

Sr. No.	Source of Livestock Feed	Number of households reported
1	Grazing land	50.9
2	Crop residues	86.6
3	Improved forage and pasture	58.1
4	Household left over	56.0
5	Tree legumes grown as hedge or any	56.0
6	Feed preservation and storage	10.7

4.7 Details of Sheds and Fodder Storages

The details of cattle shed with selected households presented in Table 4.18 indicate that very few households have cattle shed and majority of them are kuccha in nature of which few are within house. While in case of shed for sheep and goat, very few of same of kaccha nature.

Table 4.18: Details about Cattle Shed

Particulars	Pucca		Kachcha		Mixed	
	Nos.	Av value (Rs)	Nos.	Av value (Rs)	Nos.	Av value (Rs)
Cattle shed	74	68781	90	10547	10	24750
Sheep & Goat shed	04	16250	39	2540	5	11500

Note: Kachaa includes shed within house

4.8 Details of Labour and Maintenance charges

As dairy activities are carried out as complimentary activity to agriculture activities, the labour use pattern by the selected sample households indicate the significant involvement of female in dairy activity (buffalo, crossbred cows and indigenous cows) while in case of sheet and goats, male were engaged may be mostly for grazing them on the field. The time spent on management of dairy business for the stall feed animals were estimated to be around 2-3 hours per day while same was about 3-5 hours for small ruminants.

Table 4.19: Details of Labour and other Maintenance Charges

Particulars		Buffalo	Indigenous cattle	Crossbred Cattle	Sheep	Goat
Labor requirement	Male (hrs)	2.49	2.06	2.42	6.00	4.73
	Female (hrs)	2.89	2.35	2.91	2.33	2.78
Labor cost* (Rs./ year)	Male (Rs)	252.76	270.16	249.38	300.00	256.96
	Female (Rs)	249.07	266.28	240.44	300.00	253.47
Veterinary Cost (Rs/annum.)		1798.73	1501.33	3532.10	860.00	860.00
Maintenance cost (Equipments, electricity and water charges. (Rs./ annum)		1246.15	508.33	466.67	0.00	0.00
Any other cost (Rs)		0.00	0.00	0.00	0.00	0.00

Note: wages for 8 hours per day

4.9 Details of Returns from Livestock Reared

The net returns realised by the sample households are presented in Tables 4.20. It can be seen from the table that the highest milk yield realised by the sample households from buffalo (9.22 lit/day) followed 5.82 lit/day from buffalo and 5.17 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be less than a litre per day. Therefore, there is a huge scope to enhance producers' income from dairy by enhancing animals productivity, improving management practise, and ensuing remunerative prices.

Table 4.20: Returns from Livestock Rearing

Particulars		Crossbred cattle	Indigenous cattle	Buffalo	Sheep	Goat
Milk	Yield in litres	9.22	5.17	5.82	0.57	0.70
	Sales price (Rs.)	29.68	30.22	43.44	31.11	13.04
Dung	Tones	6.22	4.27	6.54	1.67	0.96
	Sales price (Rs.)	6110.79	4393.48	7338.02	2538.89	995.12
Sales details of animal	Animal weight kgs				33.65	40.59
	Number of animals				5005.00	7183.51
	Sales price (Rs.)					
Any other by-product specify	kgs/animal					
	Sales price (Rs.)	9.22	5.17	5.82	0.57	

Low productivity of milk animals is a serious constraint to dairy development. The productivity of dairy animals could be increased by crossbreeding low-yielding nondescript cows with high-yielding selected indigenous purebreds or suitable exotic breeds in a phased manner. The cattle-breeding policy should not only focus on milk yield but should also provide for the production of good-quality bullocks to meet the draft-power requirements of agriculture. Upgrading nondescript buffalo through selective breeding with high-yielding purebreds should be given high priority in all areas where buffalo are well-adapted to the agro-climatic conditions.

4.10 Chapter Summary

From field data, it was observed that on an average operational land holdings was estimated to be marginal size of holdings having 0.91 ha of which 92 per cent land was irrigated. It was very surprising and pleasant to note that almost 44 per cent of total operational holdings was devoted to fodder crops, while same was very significant in case of land under rainfed condition (72 per cent) as compared to 42 per cent land was under fodder by irrigated land holders. The groundwater the main source of irrigation followed by surface sources such as canal and tank. The cropping pattern of the selected households indicates that highest area under fodder crops was recorded during kharif and rabi season. Besides, during kharif seasons, supportive crops which by product can be used as fodder crops such as maize, bajra, moong, urad and groundnut were grown. The fodder cultivation is found to be relatively less profitable than other crops. More than 93 per cent selected buffalo and Cattle had average age of more than 2 years while around two fifth of sheet and goats were of same age. The average value of sheet and goat for the age of 2 years and above ranges between as high as around Rs. 6821/- and Rs. 6593/- in Banaskantha and as lowest as Rs. 1020/- in Panchmahal district and Rs. 1873 in Surat district, respectively.

The average value of the buffalo, crossbreed cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 48000/- , followed by Rs. 39000/- for crossbreed cattle and Rs. 30000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Banasskantha and Panchamal district than Surat. The average value of animals as per stage of life i.e. heifer not pregnant, heifer pregnant, dry and mulching animals. The average feed and fodder consumption of milch animals was ranges between 14- 16 kg of green of fodder followed by 12-14 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed to the adult animals. The quantity of feed and fodder fed to the animals were significantly high for milch animals followed by the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day. The small ruminants were mostly fed outside by taking out for grazing and very few of the households had fed them with the dry fodder and some concentrates. On an average, animals were also taken out for grazing for 7-8 hours on each day.

The total requirement of feed and fodder using the standards given by the NATP database and as per the available data of livestock census of 2012 was to be 85062 tonnes of green fodder, 415411 tones of dry fodder and 289746 tones of concentrates. With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data of the State of Gujarat for the year 2016-17 and was estimated to be 71277 tonnes. The main crops residues available for livestock in the state are Bajra, Paddy, Wheat, Pulses, Oilseeds and Sugarcane. The percent gap between the requirement and availability has been computed which indicate that State is deficit in dry fodder followed by availability of concentrates. The green fodder deficit has been estimated to the extent of 16 percent.

The major sources of livestock feed reported by the sample households are crop residues was major source of the livestock feed followed by grazing land. Half of the respondents depend on the improved forage and pastures, household left over and tree legumes grown as hedge. Very few household have reported use of feed preserved feed in storages. Very few households have cattle shed and majority of them are kaccha in nature of which few are within house. While in case of shed for sheep and goat, very few of same of kaccha nature.

As dairy activities are carried out as complimentary activity to agriculture activities, the labour use pattern by the selected sample households indicate the significant involvement of female in dairy activity (buffalo, crossbred cows and indigenous cows) while in case of sheet and goats, male were engaged may be mostly for grazing them on the field. The time spent on management of dairy business for the stall feed animals were estimated to be around 2-3 hours per day while same was about 3-5 hours for small ruminants. The net returns realised by the sample households shows that the highest milk yield realised by the sample households from buffalo (9.22 lit/day) followed 5.82 lit/day from buffalo and 5.17 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be less than a litre per day. Therefore, there is a huge scope to enhance producers' income from dairy by enhancing animals productivity, improving management practise, and ensuing remunerative prices.

The next chapter presents details on constraints faced by sample households and their suggestions.

Constraints, Views & Suggestions by Sample Households

5.1 Introduction:

After having estimation of area, production and productivity of fodder crops being fed to livestock by sample households, it is important to have the discussion on the constraints faced by sample households and their suggestions.

5.2 Constraints faced by Sample Households:

The details on constraints faced by the sample households are presented in Table 5.1. It can be seen from the table that the top most constraint faced as expected was small size of land holdings and therefore selected households cannot afford to put more land under fodder seed/crop production as they need to grow food grains and commercial crops. The other major constraints reported are no provision of quality seed by society on credit & Non availability of quality fodder seed in market; High Cost of Cultivation/Production and Low return on fodder production; non-availability of Grazing lands; and non availability of adequate irrigation water.

Table 5.1: Constraints faced by the Sample households for Fodder cultivation

Sr. No.	Constraints	Number of households ranked 1	Number of households reported
1	Land is very less therefore cannot afford to put more land under fodder seed/crop production	155	268
2	Non availability of adequate irrigation water	11	236
3	Non Availability of labour	5	216
4	Land is not suitable for fodder production	1	202
5	High Cost of Cultivation/Production and Low return on fodder production	14	217
6	Low price prevails for green fodder in market	7	203
7	High cost of fodder seed	31	205
8	No provision of quality seed by society on credit& Non availability of quality fodder seed in market	30	202
9	Non-availability of Grazing lands	14	205
10	Lack of training facilities	1	273
11	Poor Livestock extension services	2	283
12	Lack of awareness about government programmes on subsidy on seeds	6	280
13	More Laborious	5	231
14	Lack of awareness on production and post harvest techniques	0	276

5.3 Adoption of Post Harvest Techniques:

The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be sued during off seasons. It was very strange to note that despite of the fact that fodder availability has direct relation with milk productivity as well as health of the animals, almost all the households had not adopted any post harvest technique, which indicate failure of the agricultural extension mechanism/department of animal husbandry in training the farmers for such techniques (e.g. hay making, silage, etc). The major reasons for non adoption of these post harvest techniques were highly expensive to adopt the post harvest techniques (55 per cent), followed by lack of awareness on production and post harvest management (29 per cent) and considered it inferior in comparison to fresh one (14 per cent) and more laborious (2 per cent) (Table 5.3).

Table 5.2: Details on Adoption of Post-harvest Techniques

Sr. No.	Adopted Post harvest Techniques	Yes (%)	No (%)
1	Number of households	0.34	99.66

Table 5.3: Major reasons for Non-adoption Post-harvest Techniques

Sr. No.	Particulars	Households reported (% to total responses)
1	Considered inferior in comparison to fresh one	14.14
2	Highly expensive	54.48
3	Lack of awareness on production and post harvest management	29.31
4	More laborious	2.07

It was strange to note that hardly 3 per cent of total households have reported that they have benefited from government and dairy cooperative having availed cattle shed subsidy, fodder seed and loan of purchase of livestock as well as free medicine and availability of feed at dairy cooperative. Almost 97 percent of households reported that they did not received any support from the government net or dairy (Table 5.4). The top three suggestions made by the selected households were availability of quality seed in time, seed availability at subsidised rate and

Table 5.4: Benefits getting from the Government to Livestock Production

Sr. No	List of Benefits	Households reported (% to total responses)
1	Cattle shed subsidy received	0.69
2	Fodder seed, livestock purchasing loan	2.06
3	Free medicine, Feed was made available by dairy	0.34
4	No benefits received	96.91

Table 5.5: Major Suggestions to Improve Production of Fodder related crops

Sl. no	List of Suggestions	Households reported (% to total responses)
1	Make available quality fodder seed in time	43.64
2	Make available fodder seed at subsidized rate	11.00
3	Government should purchase wools from farmers.	2.06
4	Provide loan for purchase of livestock	1.37
5	Implement schemes related to fodder production, make fodder seed availability	1.03
6	Awareness on production and post harvest techniques of fodder production.	0.69
7	Subsidy given on goat rearing	0.69
8	Provided fodder/extension services	0.34
9	No suggestions	39.18

5.4 Chapter Summary:

The details on constraints faced by the sample households indicate that the top most constraint faced as expected was small size of land holdings and therefore selected households cannot afford to put more land under fodder seed/crop production as they need to grow food grains and commercial crops. The other major constraints reported are no provision of quality seed by society on credit & Non availability of quality fodder seed in market; High Cost of Cultivation/Production and Low return on fodder production; non-availability of Grazing lands; and non availability of adequate irrigation water. The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be sued during off seasons. It was very strange to note that despite of the fact that fodder availability has direct relation with milk productivity as well as health of the animals, almost all the households had not adopted any post harvest technique, which indicate

failure of the agricultural extension mechanism/department of animal husbandry in training the farmers for such techniques (e.g. hay making, silage, etc). The major reasons for non adoption of these post harvest techniques were highly expensive to adopt the post harvest techniques (55 per cent), followed by lack of awareness on production and post harvest management (29 per cent) and considered it inferior in comparison to fresh one (14 per cent) and more laborious (2 per cent). It was strange to note that hardly 3 per cent of total households have reported that they have benefited from government and dairy cooperative having availed cattle shed subsidy, fodder seed and loan of purchase of livestock as well as free medicine and availability of feed at dairy cooperative. Almost 97 percent of households reported that they did not received any support from the government net or dairy (Table 5.4). The top three suggestions made by the selected households were availability of quality seed in time, seed availability at subsidised rate and

The next chapter presents the summary and policy questions.

Major Findings and Policy Suggestions

6.1 Introduction:

Animal husbandry in India is closely interwoven with agriculture. It plays an important role in the socio-economic development of millions of rural households thereby contributing importantly in the national economy. Livestock rearing is one of the most important economic activities in the rural areas providing supplementary as well as stable income round the year. This sector has also emerged as a vital sector for ensuring a more inclusive and sustainable agriculture system. Evidence from the National Sample Survey Office's (NSSO) 70th round survey (2014 & 2014a) showed that more than one-fifth (23 per cent) of agricultural households with very small holdings of land (less than 0.01 hectare) reported livestock as their principal source of income. More than 70 million of the reported 147 million rural households depend on dairy, in varying degrees, for their livelihoods. Marginal, small and semi-medium farmers with average operational holdings of area less than 4 ha own about 87.7 per cent of the livestock of India. By controlling 64 per cent of the bovine, 70 per cent of ovine, 73 per cent of caprine and 70 per cent of the poultry population, the small holders contribute substantially to livestock production. Dairying has become an important secondary source of income for millions of poor and rural households and has assumed an important role in providing employment and income generating opportunities particularly for marginal and women farmers. This is the sector where the poor contribute to growth directly instead of deriving benefits from growth generated in other sectors of the economy. This sector has created a significant impact on equity in terms of employment and poverty alleviation as well. It cannot be merely a co-incidence that the level of rural poverty is significantly higher in states where livestock sector is underdeveloped.

6.2 Need for the study

Dairy Industry in the country has shown spectacular growth during the last few decades. With an expected production of about 188 million MT of milk by the end of 2018-19, it is estimated that annual requirement of green fodder will be to the tune of 1,100 million MT and dry fodder to the tune of 610 million MT. The current

availability of green and dry fodder, however, is estimated at 500 million MT and 380 million MT respectively. Efforts to increase livestock productivity / production is constrained by feed /fodder shortages. The shortages tend to be even more serious during natural calamities. To improve the availability of fodder, there is very little scope to increase the area under fodder cultivation, particularly in view of the growing demand of human beings for food, fiber and shelter. It is therefore necessary to increase the availability of fodder by increasing the productivity of available forage resources per unit area, improve the efficiency of fodder utilization and minimize the fodder wastages to increase and thereby reduce the gap between demand and supply. The present average green fodder yield of 40 MT/hectare/year of cultivated land and 0.75 MT/hectare/year for common grazing land are too low and there is huge potential to improve their productivity through adoption of latest technologies.

The country's estimated demand for milk is likely to be about 200 million tonnes in 2021-22 (NDDB, 2014 & 2014a). To meet the growing demand, there is a need to increase the annual incremental milk production from 4 million tonnes per year as was the case for the last 10 years to 7.8 million tonnes in the next 8 years (total 210 million by 2021-22). To meet the growing demand, it is necessary to maintain the annual growth of over 4 per cent in the next 15 years. Quantum jump in milk production is possible through increase in productivity, and linking small holders to dairy cooperatives/producer groups/SHGs with forward linkages having milk processing facilities. Adequate availability of feed and fodder to livestock is vital to increase their productivity and also to sustain ongoing genetic improvement initiatives. The supply of feeds has always remained short of normative requirement. The situation is further aggravated in Rajasthan and Gujarat where considerable area falls in arid and semi-arid zones. Keeping this background, the study examines demand, supply, and a deficit of feed and fodder production in the Gujarat.

6.3 Data and Methodology

The study is based on both, the secondary and primary level data. The study is based on both secondary and primary level statistics. The secondary data on livestock population of all selected states are compiled from published sources. To understand and analyze the demand for and supply of feed and fodder, primary data were collected from the field level through a sample survey method. As per the sampling framework, data were collected from three selected districts from three regions of the

state, i.e. Banaskantha (North Gujarat), Surat (South Gujarat), and Panchmahal (East Gujarat). The reference period of the study was 2019-20 agricultural year.

6.4 About Study Area:

Gujarat has been consistently clocking impressive agricultural growth rates. This has been possible because the government has focused on improving not only irrigation, quality of seeds and power but also subsidiary sectors like animal husbandry. The growth of the animal husbandry sector has resulted not only in increased milk production but has also provided a boost to the overall agro-economy of the state. The livestock sector in Gujarat has achieved a remarkable success during last six decades due to collective efforts of government organisations, non-government organisation and the milk producers. Gujarat is one of the leading states in terms of milk production. The cooperative sector has been the key driver of the tremendous increase in Gujarat's milk production. It is not a surprise that Gujarat, the birthplace of India's white revolution, has a thriving milk cooperative sector. The largest dairy co-operative in India, Amul, is based in Anand, Gujarat. 'Amul' pattern is well known & accepted by all states in India besides some of the countries in the world.

Animal husbandry has played a significant role in boosting the agrarian economy of the state. It is not only a subsidiary source of livelihood in rural Gujarat, it is a major economic activity, especially in the arid and semi-arid regions of the state. Thus, this sector plays a vital role in the rural economy of the state and has significant impact on employment generation for marginal, sub-marginal and landless farmers. Out of about total 102 lakhs household, about 43 lakh households have livestock in Gujarat as a primary or secondary source of income. Milk contributes around 20 per cent to the agricultural GSDP of Gujarat and is one of the biggest sectors for supporting livelihood in the state. Share of milk in livestock output at constant prices was about 86 per cent, which was not only the highest contribution but also was a noticeable share in the total livestock output.

Gujarat State has secured a remarkable position in the country as far as livestock wealth and development are concerned. As per Provisional figures of the 20th Livestock Census (2017) of India, 26.9 million livestock (5.02 % of all India) population was in the state of Gujarat. An increase in livestock population from 23.51 million in 2007 to 27.12 million in 2012 was observed and then declined between 2012 and 2017. In fact, the share of Gujarat in all India total stock of livestock

increased by 0.86 percent points during 2007 to 2012 and then declined by 0.28 percent points in 2017. As per Livestock Census 2012, among various species in Gujarat livestock, buffalo comprised of the highest share (38.28 per cent) in total livestock population followed by Cattle (36.80%), Goat (18.28 %) and Sheep (6.30 %), besides marginal share of other livestock species such as Camel, Mules, Donkeys, Horses and Ponies. Banaskantha (9.38 %) had the highest number of livestock population followed by Panchmahal (7.41%), Kachchh (7.14%), Sabarkantha (6.8%), Dahod (6.41%) and Vadodara (6.13%). These six districts together accounted for 44 percent of total livestock population in the state in 2012.

Gujarat is a leading state in terms of its quality milch animals and milk production. Gujarat ranks third among the milk producing states in India, with 144.93 lakh MT in 2018-19, an increase from the 30.9 lakh tonnes in 1983-84. Despite of increase in milk yield, there is still a wide scope for improving milk yield of milch animals. The reason cited for this is inappropriate feeding as well as inadequate supplies of quality feeds and fodder in addition to the low genetic profile of the Indigenous breeds. It is not possible to achieve higher productivity in milching animal by merely increasing its genetic potential. Due attention needs to be given to proper feeding of milching animals. There is no shortcut to sustain livestock husbandry, without addressing the development of fodder and feed resources.

As such there is lack of time series dataset regarding area under forage and fodder crops in India. While GOG 2018 (SAP & SIDP) report has highlighted area under forage crops in Gujarat which was estimated to be 2.32 lakh ha in the year 2017-18 in Gujarat. Out of the total area under forage crops in Gujarat, about one fourth of total area was in Banaskantha district followed by Mehsana having about 10 per cent of total area in the State. Other districts, having around 5 per cent area under forage crop, were Vadodara, Sabarkanta, Kachchh and Kheda. As against the estimated animals' requirements, feed resources available in Gujarat are lower. During the period 2003 to 2011, shortage of fodder was observed in the state. In context of dry matter, a reduction was observed from 137 per cent of the requirement to 66 per cent; total digestible nutrients from 200 per cent to 73 per cent while the crude protein availability increased from -98 per cent to a surplus of 19 per cent.

6.5 Findings from Field Survey

- The various socio-economic factors for instance size of family, education and training of dairy producer, availability of land and off farm income, experience in dairy, etc have direct influence on dairy farmers' decision to whether they want to expand and improve their dairy operations. Average age of the selected household head/respondent was around 46 years of which almost half of them found to be illiterate. The remaining half of the household respondents were educated mostly up to the highest level of high schools except few of them were found graduated. Out of the total selected respondents, almost 46 per cent were from backward classes, followed by around 28 per cent from Scheduled Caste, 14 per cent from Schedules Tribe and rest of them belongs to open category. Most of the selected households respondents were male (92 per cent) and very few (8 per cent) were female respondents.
- The selected households had relatively higher experience in dairy business (20 years) followed by farming (18 years) and sheep and goat rearing (10 years). The average family size was found to be 6.66 persons and the highest share of family members were found to be primarily engaged in dairy business (44 per cent) followed by 36 per cent in farming and rest of them were in sheet and goat farming. The main occupation of the selected households was agriculture comprised of cultivation of land as a farmer along with supportive allied activity of animal husbandry and dairying. Agriculture was the primary occupation of 55 per cent households followed by animal husbandry and dairy (22 per cent) and around 12 per cent were depends on labour activities. Own farm establishment and self employment were other major sources of occupation. The annual average income of the selected households was estimated to be Rs. 105756/- followed by Rs. 78705/- from dairy, Rs 6610/- from sheep and goat rearing. Around 73 per cent of the selected households were found be a member of social and cooperative organisations.
- On an average, operational land holding was estimated to be marginal size of holdings having 0.91 ha of which 92 per cent land was irrigated. It was very surprising and pleasant to note that almost 44 per cent of total operational holdings was devoted to fodder crops, while same was very significant in case of land under rainfed condition (72 per cent) as compared to 42 per cent land

- was under fodder by irrigated land holders. The groundwater the main source of irrigation followed by surface sources such as canal and tank.
- The cropping pattern of the selected households indicates that highest area under fodder crops was recorded during kharif and rabi season. Besides, during kharif seasons, supportive crops which by product can be used as fodder crops such as maize, bajra, moong, urad and groundnut were grown. The fodder cultivation is found to be relatively less profitable than other crops.
 - The details on fodder and feed fed to the animals indicate that the more than 93 per cent selected buffalo and Cattle had average age of more than 2 years while around two fifth of sheet and goats were of same age. The average value of sheet and goat for the age of 2 years and above ranges between as high as around Rs. 6821/- and Rs. 6593/- in Banaskantha and as lowest as Rs. 1020/- in Panchmahal district and Rs. 1873 in Surat district, respectively.
 - The average value of the buffalo, crossbred cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 48000/- , followed by Rs. 39000/- for crossbred cattle and Rs. 30000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Banasskantha and Panchamal district than Surat. The average value of animals as per stage of life i.e. heifer not pregnant, heifer pregnant, dry and mulching animals.
 - The details on the fodder and feed fed to the milch animals indicate that the average feed and fodder consumption of milch animals was ranges between 14-16 kg of green of fodder followed by 12-14 kg of dry fodder, 2-3 kg of concentrates and very few quantity of the supplements were fed to the adult animals. The quantity of feed and fodder fed to the animals were significantly high for milch animals followed by the heifer pregnant, dry animals and rest of them. Besides stall feeding, the animals were also taken out for grazing for few years on each day. The small ruminants were mostly fed outside by taking out for grazing and very few of the households had fed them with the dry fodder and some concentrates. On an average, animals were also taken out for grazing for 7-8 hours on each day.
 - The total requirement of feed and fodder using the standards given by the NATP database and as per the available data of livestock census of 2012 was to be 85062 tonnes of green fodder, 415411 tones of dry fodder and 289746

tones of concentrates per day. With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data of the State of Gujarat for the year 2016-17 and was estimated to be 71277 tonnes. The main crops residues available for livestock in the state are Bajra, Paddy, Wheat, Pulses, Oilseeds and Sugarcane. The percent gap between the requirement and availability has been computed which indicate that State is deficit in dry fodder followed by availability of concentrates. The green fodder was estimated to the by 30 per cent than requirement.

- The major sources of livestock feed reported by the sample households are crop residues was major source of the livestock feed followed by grazing land. Half of the respondents depend on the improved forage and pastures, household left over and tree legumes grown as hedge. Very few household have reported use of feed preserved feed in storages. Very few households have cattle shed and majority of them are kuccha in nature of which few are within house. While in case of shed for sheep and goat, very few of same of kaccha nature.
- As dairy activities are carried out as complimentary activity to agriculture activities, the labour use pattern by the selected sample households indicate the significant involvement of female in dairy activity (buffalo, crossbred cows and indigenous cows) while in case of sheet and goats, male were engaged may be mostly for grazing them on the field. The time spent on management of dairy business for the stall feed animals was estimated to be around 2-3 hours per day while same was about 3-5 hours for small ruminants. The net returns realised by the sample households shows that the highest milk yield realised by the sample households from buffalo (9.22 lit/day) followed 5.82 lit/day from buffalo and 5.17 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be less than a litre per day. Therefore, there is a huge scope to enhance producers' income from dairy by enhancing animals productivity, improving management practise, and ensuing remunerative prices.
- The details on constraints faced by the sample households indicate that the top most constraint faced as expected was small size of land holdings and therefore selected

households cannot afford to put more land under fodder seed/crop production as they need to grow food grains and commercial crops. The other major constraints reported are no provision of quality seed by society on credit & Non availability of quality fodder seed in market; High Cost of Cultivation/Production and Low return on fodder production; non-availability of Grazing lands; and non availability of adequate irrigation water.

- The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be sued during off seasons. It was very strange to note that despite of the fact that fodder availability has direct relation with milk productivity as well as health of the animals, almost all the households had not adopted any post harvest technique, which indicate failure of the agricultural extension mechanism/department of animal husbandry in training the farmers for such techniques (e.g. hay making, silage, etc). The major reasons for non adoption of these post harvest techniques were highly expensive to adopt the post harvest techniques (55 per cent), followed by lack of awareness on production and post harvest management (29 per cent) and considered it inferior in comparison to fresh one (14 per cent) and more laborious (2 per cent).
- It was strange to note that hardly 3 per cent of total households have reported that they have benefited from government and dairy cooperative having availed cattle shed subsidy, fodder seed and loan of purchase of livestock as well as free medicine and availability of feed at dairy cooperative. Almost 97 percent of households reported that they did not received any support from the government net or dairy. The top three suggestions made by the selected households were availability of quality seed in time, seed availability at subsidised rate.

6.6 Conclusions and Policy Recommendations:

- Animal husbandry plays a vital role in Gujarat's rural economy contributing 5.32 per cent to the state GSDP in 2013-14, while the contribution of agriculture to total GSDP was 16.83 per cent. Milk contributes around 20 per cent to the agricultural GSDP of Gujarat and is one of the biggest sectors for supporting livelihood in the state. This suggests that public investment in the

livestock sector should be enhanced to help the smallholder livestock producer, which derives their larger share of income from the livestock sector.

- Dairy industry can serve as a cushion in the form of continuous flow of income as an industry complementary to the agricultural industry. While both agriculture and dairy industry if simultaneously operate it can improve not only farmer's income but also compensate for unexpected losses faced due to agriculture especially for poor small and marginal farmers. Besides such complementarily protects against seasonal and disguised unemployment and acts as a shield to protect farmer against the negative impact of climate change on agriculture.
- Shortage of quality dry fodder and concentrates is major constraint for livestock sector growth. The gap between the requirement and availability of feed and fodder is increasing due to decreasing area under fodder cultivations and reduced availability of crop residues as fodder. Also there is continuous shrieking of common property resources leading to over grazing on the existing grass land. Therefore, there is a need to work out the strategies for sufficient good quality feed and fodder for efficient utilisation of genetic potential; of the various livestock species and for sustainable improvement in productivity.
- Improvement in nutritional rationed balanced diet can create a positive impact on yield thereby improving net income and optimum use of available fodder and feed with households. Ration Balancing Program (RBP) results in better health of animal, improves the milk composition and the yield, improves conception rate and thereby lactation cycle improves due to reduction in the dry rate. Hence it is suggested that if the local educated youth of the village are involved in the form of Local Resource Persons (LRPs) it would result in the optimum utilization of the locally available resources in the form of fodder and labor as also the rural employment rate will improve. In the process such positive interventions would have multifold effect in net dairy income and reduction in the quantity of BEP through reduction in cost and improvement in income through improved quality of milk. Such benefits can be assured through proper assessment mechanism form RBP.

- Fodder forms a major component of the variable cost in the dairy industry. If the feed and fodder cost is reduced it can result in improvement in net income and reduce the BEP quantity.
- Fodder is the major component of the variable cost. Hence fodder community farming farms should be encouraged, benefits assessed, and should be effectively communicated to the dairy farmers. Co-operative farming of fodder particularly on the barren land of the village can assure sufficient local availability of the fodder and thereby reduce the variable cost, create a positive impact on net income.
- The co-operative structure is very weak in Saurashtra and Kachchh regions of the state. Therefore, presence of Milk Producer Company's sales & distribution network is spread across Saurashtra & Kutch region support the dairy development in this regions. Therefore, there is a need to support the MPCs in all the areas for balanced development of dairy sector.

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Details on Fodder Development Programmes & Seed distributed/Imported

A1.1: Ongoing Fodder Development Programmes of DAD & F, GOI

S.N	Name of the Components
1	Fodder Production from Non-forest wasteland/rangeland/grassland/non-arable land
2	Fodder production from Forest land
3	Fodder Seed Procurement/ Production & Distribution
4	Introduction of Hand Driver Chaff-Cutter
5	Introduction of Power Driven Chaff Cutter
6	Distribution of low capacity, tractor mountable Fodder Block Making units, hay baling Machines/reapers/ forage harvesters
7	Established of silage making Units
8	Establishment of by-pass protein production units
9	Establishment of Area Specific Mineral Mixture/Feed pelleting/feed Manufacturing Units
10	Establishment/modernization of feed Testing Laboratories

Source: GOI (2017).

A.1.2: State wise release of funds under Sub Mission Feed and Fodder of National Livestock Mission

State & UTs	2014-15 (Rs. In lakh)	2015-16 (Rs. In lakh)	2016-17 (Rs. In lakh)
Andaman & Nicobar	NA	NA	2.25
Andhra Pradesh	NA	NA	558.00
Bihar	343.00	NA	
Chhatisgarh	NA	212.61	41.57
Gujarat	1500.00	NA	1095.83
Haryana	490.00	NA	
Himachal Pradesh	74.99	NA	
Jharkhand	500.00	NA	200.00
Karnataka	NA	422.00	1.04255
Maharashtra	157.14	500.00	1338.205
Nagaland	39.94	23.25	
Odisha	178.50	72.60	131.40
Rajasthan	NA	338.817	177.45
Sikkim	7.65	15.11	
Tamil Nadu	600.00	NA	
Tripura	5.70	NA	
Uttarakhand	NA	101.55	
Uttar Pradesh	321.00	NA	
West Bengal	550.35	NA	27.72
Total	4768.27	16.85.937	3573.4675

Source: GOI (2017).

A. 1.3: Component wise physical progress for all India under NLM

Sl.	Component	201-15	2015-16	2016-17	Total
1	Fodder Production from Non-forest wasteland/rangeland/grassland/non-arable land (Ha)	535	NA	715	1250
2	Fodder production from Forest land (ha)	NA	45	100	145
3	Fodder Seed Procurement/ Production & Distribution (Qtls)	46031.1	44778.44	5511.15	96320.69
4	Introduction of Hand Driver Chaff-Cutter(Nos)	21516	3634	600	25750
5	Introduction of Power Driven Chaff Cutter (Nos)	9307	12331	7522	29160
6	Distribution of low capacity, tractor mountable Fodder Block Making units, hay baling Machines/reapers/ forage harvesters (Nos)	2	0	0	2
7	Established of silage making Units (Nos)	2272	56	1495	3823
8	Establishment of by-pass protein production units (Nos)	3	0	0	3
9	Establishment of Area Specific Mineral Mixture/Feed pelleting/feed Manufacturing Units (Nos)	1	0	0	1
10	Establishment/modernization of feed Testing Laboratories (Nos)	5	0	2	7

Source: GOI (2017).

A.1.4: Physical Achievement for Feed & Fodder Development

Sr. No.	Name of the Component	2014-15	2015-16	2016-17	Total
1	Hand driven Chaff Cutter(nos)	21516	3634	600	25750
2	Power Driven Chaff Cutter(nos)	9307	12351	7522	29180
3	Silage Making Unit (nos)	2272	56	1495	3823
4	Fodder Seed Distribution(in Qt.)	46031	44778	5511	96320
5	Fodder Production For non-forest(in ha)	535	Nil	715	1250
6	Fodder Production From forest(in ha)	Nil	45	100	145

A 1.5: Import of Berseem seed variety i.e. Mescavi

Sr No	Year	Import (MT)
1	2004-05	2062
2	2005-06	2930
3	2006-07	7912
4	2007-08	7622
5	2014-15	13204
6	2016-17	10474

Source: NITI Ayog (2018); GOI (2017)

A. 1.6: Fodder Seeds produced and Distributed/sold to the States during 2014-15 to 2016-17

Name of the station	Fodder Crop/Grass/Variety	Price (Rs/Kg)	Quantity of seed produce			Quantity procured by the states		
			2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
RFS Chennai (kgs)	Cowpea EC4216	100	9900	7703	6330	4050	5750	7500
	Sorghum CO-29	400	1202	1468	1870	0	600	800
	Stylosanthes	350	18.5	1617	1811.5	400	852	1020
	Calopogonium	200	18	67	0	0	0	0
RFS Bangalore	Maize African Tall	50	1730.76	733.5	605.08	1216	1060	1018.5
	Sorghum MP chari	52.50	59.22	1.74	227.9	0	0	0
	PC23	65.00	146.3	144.8		145	24	
	CoFS 29	350		14.44				
	Cowpea EC4216	75	26	29.86	0	0	20.5	6.0
	Rhodes Callide	450	18.21	14.90	19.03	0.20	1.0	1.5
RFS Hyderabad	Guinea Grass	400	10.3	12.05	36.99	0.2	1.0	1.0
	Signal Congo	400	0.91	0	3.36			
	Maize African Tall	50	5895	9608	11012	4575	6917	4273
	Sorghum PC23	55	8340	5387.5	1377	6200	5000	101
	Sorghum CoFS 29	380	0	48	52	0	42	40
	Cowpea APFC-10-1	90	183	14	78			45
	Oats UPO 212	50	142	530	0	85	510	0
	Guinea	400	0	29	384	0	22	140
RFS Kalyani	Stylo	400	0	14	156	0	10	45
	Rhodes Callide	400	36	6	12	8	0	5
	Cenchrus	400	106	187.5	134	94	177	30
	Maize J 1006		31842	36125	8751	28576	2048	8751
	Ricebean		15800	559	3330	2829	2751	583
RFS Dhamrod	Bidhan							
	Sorghum PC-23		5403	489	120	1422	4054	1865
	Cowpea BL-1,2		5797	3235	2580			
	Sorghum MP chari	50		4690	5923		2301	
	Sorghum PC-23	50	1650	0	0	0	1050	
	Sorghum CoFS 29	400	840	955	266	0	1715	
RFS Hisar	Sorghum PC-9	350		3635	659	1145	1400	965
	Sorghum CSV-21F	50		240	419			
	Bajra HC-20	65	440	535	940	0	156	
	Chinese Cabbage	70	7660	4610	1120	10	3500	800
	Bajra hc 20	30	440	1400	6980	915	0	8000
	teosinite	45	340	620	1380	0	0	0
	Sorghum MP chari	45	0	160	1730	0	0	1000
	Sorghum PC-23	45	0	4660	4480	0	0	1450
	PC09	45	0	0	1266	0	0	1045
	Oats HJ8	45	25210	6400	5195	2778	1505	500
RFS Suratgarh	Oats OS6	40	24229	800	7093	7748	0	5000
	Oats Kent	40	5655	2660	21410	2048	125	15000
RFS Srinagar	Tall Fesue Demeter	550	130	330	200	6	9	12.5
	Orchard Grass	550	8	30	10	0.5	9	1.5
	Orchard Grass-commit							
	Orchard Grass-currries	550	7	20	33	0.5	2	1.5
	Orchard Grass – Apunui	550	0	0	0			
	Annual Rye Grass	250	338	350	985	1	206	1.5
	Grassland Manwa							
	Saifoin Melrose	550	12	30	16	0.5	2	2
	Crown Vetch-Local							
	Red Clover	550	38	35	120	1	7	1.5
	Oat-Subjar	55			250			

Source: GOI (2017).

A 1.7: NDP I- Components and Sub-components with Project Outlay

Sr. No.	Particulars	Outlay (Rs. in Crore)				% to Total Outlay
		IDA Credit	GoI's Share	EIA's share	Total Outlay	
A	Productivity Enhancement	1026	114	22	1162	56.90
(a)	Production of high genetic merit (HGM) cattle and buffalo bulls and import of bulls/ semen/ embryos of HF and Jersey breeds for semen production.	267	30	0	297	14.54
(b)	Strengthening existing Semen Stations/ Starting new stations for producing high quality disease free semen doses	213	24	22	259	12.68
(c)	Setting up a pilot model for viable doorstep AI delivery services (based on Standard Operating Procedures [SOPs]) through a professional service provider including animal tagging and performance record	163	18	0	181	8.86
(d)	Scientific nutrition programme for milch animals to produce milk commensurate with their genetic potential and to reduce methane emission	383	42	0	425	20.81
	i) Ration Balancing Programme	324	36	0	360	17.63
	ii) Fodder Development	59	6	0	65	3.18
B	Village based milk procurement systems for weighing, testing quality of milk received and making payment to milk producers	439	49	259	747	36.58
C	Project Management & Learning	119	13	0	132	6.46
(a)	a) ICT for MIS	53	6	0	59	2.89
(b)	b) Learning and Evaluation	66	7	0	73	3.57
D	Grand Total	1584	176	282	2042	100.00

Source: <http://www.nddb.org/services/animalnutrition/rationbalance>

Details on Districtwise Fodder Production, Requirement and Consumption in Gujarat

A.4.1: District-wise Area under Fodder Crops in Gujarat

Sr. No	Districts	Area under Fodder Crops ('000 ha)						Gross Sown Area ('000 ha)					
		2000-01	2003-04	2004-05	2005-06	2006-07	2007-08	2000-01	2003-04	2004-05	2005-06	2006-07	2007-08
1	Ahmedabad	110	86	89	96	97	91	533	558	576	597	640	641
2	Amreli	33	45	44	39	26	21	545	577	584	599	596	633
3	Anand	10	16	15	15	15	15	195	294	298	307	297	306
4	Banaskantha	93	99	90	76	80	72	1,008	1,034	968	1,029	985	1,032
5	Bharuch	25	16	19	18	13	10	325	339	339	319	338	344
6	Bhavnagar	73	72	79	68	68	46	544	623	582	650	654	687
7	Dahod	4	5	5	4	4	3	193	300	303	310	309	339
8	Gandhinagar	27	37	29	31	28	21	204	200	193	187	203	216
9	Jamnagar	40	44	45	42	38	36	594	691	674	709	708	755
10	Junagadh	28	38	32	34	34	24	544	684	701	734	787	796
11	Kachchh	117	112	105	112	91	112	655	728	648	608	702	704
12	Kheda	14	19	19	20	18	22	352	403	433	407	405	426
13	Mehsana	81	86	84	84	79	63	457	447	437	449	451	468
14	Narmada	5	5	3	3	4	3	111	120	120	118	113	114
15	Navsari	46	30	26	21	12	24	174	170	171	146	151	162
16	Panchmahals	12	8	8	8	8	4	270	298	309	303	303	316
17	Patan	72	81	87	91	88	90	423	422	422	447	498	487
18	Porbandar	10	11	9	10	8	8	125	134	135	148	159	169
19	Rajkot	36	36	32	34	32	24	726	869	849	888	904	889
20	Sabarkantha	40	48	38	36	34	27	519	533	524	530	574	616
21	Surat	51	45	38	38	36	26	490	463	470	489	502	304
22	Surendranagar	81	65	57	47	58	77	721	734	734	757	762	845
23	Tapi						10						191
24	The Dangs	4	3	3	3	3	3	57	58	59	57	58	58
25	Vadodara	38	27	28	29	27	18	554	565	553	551	556	554
26	Valsad	49	46	45	N*	N*	N*	178	178	177	154	153	160
	GUJARAT	1,099	1,081	1,029	959	901	850	10,497	11,421	11,257	11,495	11,807	12,211

Note: * Negligible

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.

A. 4.2: District-wise Dry Matter (DM) Availability, Requirement and Balance

Districts	Available/ Required/ Balance	Dry Matter Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Ahmedabad	Available	842.6	878	695.8	979.8	1,092.60	990.1	1,012.10	1,529.50
	Required	-	1,441.10	1,627.10	1,731.30	1,763.30	1,800.80	1,844.50	1,895.10
	Balance	-	-563.2	-931.4	-751.5	-670.8	-810.7	-832.3	-365.7
Amreli	Available	719.5	1,636.50	1,209.40	1,113.90	1,926.00	1,099.90	742.5	1,871.20
	Required	-	1,362.40	1,304.90	1,375.50	1,385.90	1,399.50	1,416.90	1,438.70
	Balance	-	274.1	-95.5	-261.7	540.1	-299.6	-674.4	432.5
Anand	Available	-	-	176.1	659.4	852.8	777	797.9	961.1
	Required	-	1,657.50	1,607.00	2,072.60	2,180.20	2,299.50	2,431.50	2,577.50
	Balance	-	-	-1,430.90	-1,413.20	-1,327.40	-1,522.50	-1,633.60	-1,616.40
Banaskantha	Available	1,149.70	1,380.10	1,235.60	1,713.10	2,214.80	1,635.70	1,538.10	2,416.40
	Required	-	2,979.10	3,788.60	4,741.10	4,982.10	5,248.70	5,544.30	5,872.90
	Balance	-	-1,599.00	-2,553.00	-3,028.00	-2,767.40	-3,613.00	-4,006.20	-3,456.50
Bharuch	Available	763	837.1	628.6	570.1	478.2	507.5	474.1	555.5
	Required	-	857.3	865	836.6	839.8	846.9	857.9	873.4
	Balance	-	-20.1	-236.5	-266.6	-361.6	-339.4	-383.9	-317.9
Bhavnagar	Available	887	1,690.50	1,477.90	1,565.20	1,795.60	1,487.10	1,048.00	1,866.40
	Required	-	1,859.40	2,061.30	2,092.00	2,105.10	2,121.10	2,140.20	2,162.80
	Balance	-	-168.9	-583.4	-526.8	-309.4	-634	-1,092.20	-296.4
Dahod	Available	-	-	219.2	520	839.9	786	633.5	1,034.80
	Required	-	2,288.80	1,789.80	2,079.20	2,145.20	2,215.70	2,291.10	2,371.80
	Balance	-	-	-1,570.70	-1,559.30	-1,305.30	-1,429.80	-1,657.60	-1,337.00
Gandhinagar	Available	166.7	128	184.4	389.6	491.7	420.2	368.6	420
	Required	-	1,084.90	1,518.60	1,717.20	1,766.80	1,820.80	1,879.20	1,942.30
	Balance	-	-956.9	-1,334.30	-1,327.60	-1,275.20	-1,400.50	-1,510.50	-1,522.30
Jamnagar	Available	601.9	1,586.00	605.7	2,080.60	2,475.10	2,434.30	2,471.10	2,715.20
	Required	-	1,522.50	1,733.90	1,797.30	1,798.40	1,802.40	1,809.40	1,819.30
	Balance	-	63.4	-1,128.20	283.3	676.7	631.9	661.7	895.9
Junagadh	Available	1,387.60	2,616.80	1,747.10	2,471.70	3,266.30	3,215.00	2,053.30	4,041.10
	Required	-	2,227.40	2,253.20	2,437.90	2,475.90	2,519.10	2,567.80	2,622.50
	Balance	-	389.3	-506.2	33.9	790.4	695.9	-514.5	1,418.60
Kachchh	Available	1,351.10	1,290.80	1,299.90	1,650.90	1,813.80	1,519.30	1,675.90	1,833.30
	Required	-	1,738.60	1,640.10	1,950.70	2,025.00	2,106.60	2,196.30	2,294.70
	Balance	-	-447.8	-340.2	-299.8	-211.2	-587.3	-520.4	-461.4
Kheda	Available	957.3	1,372.20	1,104.00	890.2	1,183.60	1,017.70	900.3	1,378.30
	Required	-	2,055.60	2,291.50	2,711.80	2,820.40	2,939.60	3,070.70	3,215.20
	Balance	-	-683.3	-1,187.60	-1,821.60	-1,636.70	-1,921.90	-2,170.40	-1,836.90
Mehsana	Available	1,230.90	1,325.80	742.2	737.6	867.4	784.8	819.8	961.5
	Required	-	2,289.70	2,305.00	2,707.30	2,805.50	2,912.40	3,029.10	3,156.80
	Balance	-	-964	-1,562.90	-1,969.70	-1,938.10	-2,127.70	-2,209.30	-2,195.30
Narmada	Available	-	-	113.2	248.9	258.1	276.7	247.3	312.8
	Required	-	474.9	588.5	498	482.6	468.9	456.7	446.3
	Balance	-	-	-475.2	-249.1	-224.6	-192.1	-209.5	-133.5
Navsari	Available	-	-	102.8	383.6	304.2	295.7	331.1	445.3
	Required	-	759.4	931.1	814.8	800.8	789.8	781.7	776.5
	Balance	-	-	-828.3	-431.1	-496.6	-494.1	-450.6	-331.2
Panchmahals	Available	986.9	1,653.20	1,488.30	478.9	932.8	794.7	620.3	942
	Required	-	2,131.70	3,077.00	3,304.10	3,329.30	3,359.80	3,395.70	3,437.20
	Balance	-	-478.5	-1,588.80	-2,825.20	-2,396.50	-2,565.10	-2,775.30	-2,495.20
Patan	Available	-	-	308.5	554.4	665.3	629	574.6	731.1
	Required	-	1,371.50	1,136.60	1,636.00	1,763.50	1,904.30	2,059.80	2,231.40
	Balance	-	-	-828.1	-1,081.70	-1,098.20	-1,275.30	-1,485.20	-1,500.30
Porbandar	Available	-	-	129.1	567.8	572.1	697.6	581.4	493.5
	Required	-	506.6	565.7	586.6	592	598.7	606.7	615.9
	Balance	-	-	-436.6	-18.9	-19.9	98.9	-25.3	-122.5
Rajkot	Available	911.2	2,251.80	851.5	1,818.20	3,303.10	2,135.00	1,371.20	3,289.20
	Required	-	2,118.00	2,220.00	2,429.90	2,476.10	2,529.00	2,589.20	2,657.20
	Balance	-	133.9	-1,368.50	-611.6	827	-394	-1,218.00	632
Sabarkantha	Available	1,070.40	1,428.30	1,093.90	1,166.40	1,540.00	1,323.40	1,225.00	1,797.60
	Required	-	3,220.10	3,922.60	4,221.90	4,297.50	4,380.50	4,471.50	4,571.00
	Balance	-	-1,791.90	-2,828.70	-3,055.50	-2,757.50	-3,057.10	-3,246.40	-2,773.40

A. 4.2 continues....

Districts	Available/ Required/ Balance	Dry Matter Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Surat	Available	1,223.80	1,277.50	1,108.20	1,218.10	778.1	596.9	604.1	628.4
	Required	-	-	2,613.60	2,679.00	2,705.50	2,743.20	2,793.40	2,858.00
	Balance	-	-	-1,505.30	-1,460.90	-1,927.40	-2,146.30	-2,189.30	-2,229.60
Surendranagar	Available	687.8	942.4	804.1	1,213.90	1,329.20	1,136.20	1,008.90	1,410.80
	Required	-	-	1,445.80	1,825.00	1,904.10	1,989.40	2,081.40	2,180.80
	Balance	-	-	-641.7	-611.1	-574.8	-853.2	-1,072.50	-769.9
The Dangs	Available	104	126.7	144.7	184.6	193.1	199	164.8	192.6
	Required	-	-	250.5	219.8	212.9	207.2	202.7	199.3
	Balance	-	-	-105.9	-35.2	-19.9	-8.3	-37.9	-6.7
Vadodara	Available	858.5	1063.3	957.4	982.5	1,212.80	1,213.40	1,018.50	1,799.10
	Required	-	-	2,506.70	2,717.20	2,763.60	2,815.30	2,873.10	2,937.90
	Balance	-	-	-1,549.30	-1,734.60	-1,550.80	-1,602.00	-1,854.60	-1,138.80
Valsad	Available		679.3	512.4	357.4	323.1	325.2	304	344.3
	Required		-	852.5	1,059.70	1,111.50	1,171.80	1,242.20	1,324.60
	Balance		-	-340.1	-702.3	-788.4	-846.6	-938.2	-980.3

A. 4.3: District-wise Crude Protein (CP) Availability, Requirement and Balance

Districts	Available/ Required/ Balance	Crude Protein Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Ahmedabad	Available	124.9	124.3	89.2	183.1	214	187.5	221.3	393.9
	Required	-	130.1	147.3	160.9	164.6	168.9	173.7	179.2
	Balance	-	-5.7	-58	22.2	49.3	18.6	47.6	214.6
Amreli	Available	61.7	245.7	155.5	327.8	464.6	299.6	220.7	518
	Required	-	117.3	113.1	120.8	122.4	124.4	126.7	129.4
	Balance	-	128.3	42.5	207	342.2	175.2	94.1	388.6
Anand	Available		-	-	81.1	115.2	101.7	100.8	120.8
	Required		157.6	152.9	211.2	223.4	236.9	251.8	268.3
	Balance		-	-	-130.1	-108.2	-135.2	-151	-147.5
Banaskantha	Available	110.9	151.2	117.1	229.2	288.3	192.6	192.5	276.2
	Required	-	266.4	345.8	444.1	469.5	497.6	528.8	563.5
	Balance	-	-115.3	-228.7	-214.9	-181.2	-305	-336.3	-287.3
Bharuch	Available	93.7	97.2	115.4	119.4	93.8	92.3	92.5	106.4
	Required	-	75.4	77.2	75.5	76	76.8	77.9	79.3
	Balance	-	21.8	38.2	43.9	17.8	15.5	14.7	27
Bhavnagar	Available	90.7	226.7	214	473.2	556.2	407.1	281.3	542.7
	Required	-	168.9	185.4	192.6	194.7	197	199.7	202.7
	Balance	-	57.8	28.6	280.6	361.6	210.1	81.6	340
Dahod	Available		-	-	60.7	86.6	54.3	47.1	86.7
	Required		189.9	150	178.8	185.6	192.9	200.7	209
	Balance		-	-	-118.1	-99.1	-138.5	-153.6	-122.3
Gandhinagar	Available	25	19.7	15.1	70.5	97.1	80.2	76.3	83.4
	Required	-	96.9	139.9	161.8	167.2	173	179.3	186.1
	Balance	-	-77.2	-124.8	-91.3	-70.1	-92.8	-103	-102.7
Jamnagar	Available	-	199	-	471.6	522.4	452.9	492	548.5
	Required	-	131.2	152	156.4	156.9	157.8	158.8	160.1
	Balance	-	67.9	-	315.2	365.5	295.1	333.2	388.4
Junagadh	Available	141.1	346.8	213	422.9	571	530.3	334.9	669.8
	Required	-	193	197.7	216	220.2	225	230.2	236
	Balance	-	153.8	15.3	206.9	350.8	305.4	104.7	433.8
Kachchh	Available	100.4	96.3	97.8	179	208	177.2	215.2	243.1
	Required	-	159.8	152.6	183.2	190.7	198.9	207.8	217.6
	Balance	-	-63.5	-54.8	-4.2	17.3	-21.7	7.4	25.6
Kheda	Available	87.5	156.7	117.3	122.6	173.8	145.2	142.1	192.3
	Required	-	186.6	208.9	253.1	264.4	276.9	290.5	305.5
	Balance	-	-29.8	-91.6	-130.5	-90.7	-131.7	-148.4	-113.2

A. 4.3 continues....

Districts	Available/ Required/ Balance	Crude Protein Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Mehsana	Available	177.4	205.7	104.7	121	146.6	126.2	158.7	174
	Required	-	209.3	213	254.1	264.3	275.4	287.5	300.8
	Balance	-	-3.6	-108.3	-133.1	-117.7	-149.2	-128.8	-126.8
Narmada	Available	-	-	-	44.2	40.6	43.2	44.2	55.1
	Required	-	40.6	50.2	42.7	41.5	40.3	39.2	38.3
	Balance	-	-	-	1.4	-0.8	2.9	4.9	16.8
Navsari	Available	-	-	-	57.3	40.5	39.3	45.1	66.5
	Required	-	71.6	87.7	79.6	78.5	77.7	77.1	76.7
	Balance	-	-	-	-22.4	-38.1	-38.4	-32	-10.2
Panchmahals	Available	74.6	142.8	89.9	44.7	82.4	61.6	48.9	75.4
	Required	-	179.2	264.2	287.1	290	293.4	297.2	301.4
	Balance	-	-36.4	-174.4	-242.4	-207.7	-231.8	-248.3	-226
Patan	Available	-	-	-	82.1	100.2	97.7	93.7	121
	Required	-	121.9	102.9	148.7	160.6	173.6	188.1	203.9
	Balance	-	-	-	-66.7	-60.4	-75.9	-94.3	-83
Porbandar	Available	-	-	-	87.6	89.9	100.4	73.7	72.1
	Required	-	44.2	49	51.8	52.4	53.2	54	55
	Balance	-	-	-	35.9	37.5	47.2	19.7	17.1
Rajkot	Available	101.8	381.7	70.6	587.9	806.3	542.6	439.9	882.5
	Required	-	184.8	194.7	215.3	220.3	225.9	232.1	238.9
	Balance	-	196.8	-124.2	372.6	586	316.7	207.8	643.6
Sabarkantha	Available	92.1	139.4	77.8	183.3	246	217.8	202	297.9
	Required	-	286.3	354	387.6	396.1	405.4	415.6	426.5
	Balance	-	-146.8	-276.2	-204.3	-150.1	-187.6	-213.5	-128.6
Surat	Available	170	175.2	166.6	191	96.8	73.2	70.5	80.3
	Required	-	-	239.4	248.3	251.7	256.1	261.7	268.7
	Balance	-	-	-72.9	-57.3	-154.9	-182.9	-191.2	-188.4
Surendranagar	Available	88.9	187.6	112.3	366.4	410.9	298.9	327.2	541
	Required	-	-	130.5	166.7	174.8	183.6	193	203.2
	Balance	-	-	-18.2	199.7	236	115.3	134.2	337.8
The Dangs	Available	5.2	9	9	14.4	16.1	16.2	12.8	18.1
	Required	-	-	20.8	19	18.5	18	17.7	17.4
	Balance	-	-	-11.8	-4.7	-2.4	-1.8	-4.8	0.7
Vadodara	Available	99.8	156.9	128.4	187.9	223.8	241.1	219.8	324.5
	Required	-	-	220.4	240.8	245.4	250.6	256.2	262.3
	Balance	-	-	-92	-52.9	-21.7	-9.5	-36.3	62.2
Valsad	Available	-	96.3	80.9	52.5	45.6	45.7	35.7	43.4
	Required	-	-	77.4	97.1	102.2	108	114.7	122.6
	Balance	-	-	3.5	-44.6	-56.6	-62.3	-79	-79.3

Note and Source: Same as in A.4.1

A. 4.4: District-wise Total Digestive Nutrient (TDN) Availability, Requirement and Balance

Districts	Available/ Required/ Balance	Total Digestive Nutrient Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Ahmedabad	Available	612	507.5	408.7	828.3	969.2	780.7	843.5	1,547.90
	Required	-	899.7	1,016.40	1,082.50	1,103.20	1,127.50	1,156.10	1,189.40
	Balance	-	-392.2	-607.7	-254.2	-134	-346.8	-312.5	358.5
Amreli	Available	286.5	783	506.2	441	921.5	471.8	211.3	896.5
	Required	-	891.5	849	898.1	903.7	911.7	922.4	936.1
	Balance	-	-108.5	-342.8	-457.1	17.8	-439.9	-711.1	-39.6
Anand	Available	-	-	-	527	745.9	661	668.4	793.5
	Required	-	1009.8	966.8	1261.4	1,327.60	1,401.20	1,482.80	1,573.30
	Balance	-	-	-	-734.4	-581.7	-740.1	-814.3	-779.8
Banaskantha	Available	562.7	702.3	637.2	953.8	1,274.00	813.2	834.9	1,367.10
	Required	-	1,863.30	2,359.80	2,984.40	3,141.60	3,315.90	3,509.60	3,725.40
	Balance	-	-1,161.00	-1,722.70	2,030.70	-1,867.60	-2,502.70	-2,674.70	-2,358.30
Bharuch	Available	497.2	401.1	419.1	368.6	234.9	248.2	222.1	273.8
	Required	-	545.7	552.9	530.8	533	537.8	545.6	556.6
	Balance	-	-144.6	-133.8	-162.2	-298.1	-289.6	-323.5	-282.7
Bhavnagar	Available	325.8	697.9	603.8	598.3	760.4	578.7	309.9	718.9
	Required	-	1,193.40	1,311.90	1,344.60	1,355.00	1,367.30	1,381.90	1,398.70
	Balance	-	-495.5	-708.1	-746.3	-594.6	-788.7	-1,072.00	-679.7
Dahod	Available	-	-	-	382	552.2	375.5	319.4	527.3
	Required	-	1,640.40	1,272.70	1,468.40	1,513.90	1,562.50	1,614.70	1,670.60
	Balance	-	-	-	1,086.40	-961.7	-1,187.00	-1,295.20	-1,143.40
Gandhinagar	Available	152.6	96.4	89.5	278.5	403.6	287.2	259.3	336.6
	Required	-	664.1	916.9	1,035.40	1,065.30	1,097.90	1,133.30	1,171.70
	Balance	-	-567.8	-827.4	-756.9	-661.7	-810.8	-874	-835.1
Jamnagar	Available	196.2	669.3	178.9	932.1	1,161.30	1,094.40	1,094.10	1,326.60
	Required	-	1,004.20	1,134.90	1,182.50	1,180.40	1,180.40	1,182.50	1,186.70
	Balance	-	-334.9	-956	-250.4	-19	-85.9	-88.3	139.8
Junagadh	Available	633.8	1,279.60	770.3	1,719.80	2,269.80	2,003.50	1,290.40	2,804.90
	Required	-	1,464.50	1,482.20	1,606.20	1,629.90	1,657.10	1,688.20	1,723.60
	Balance	-	-184.9	-711.9	113.7	639.9	346.4	-397.8	1,081.40
Kachchh	Available	559.8	522.8	548.4	740.7	830.5	649	743.1	843.5
	Required	-	1,124.00	1,050.40	1,240.00	1,286.10	1,337.30	1,394.00	1,457.00
	Balance	-	-601.2	-502	-499.2	-455.5	-688.2	-651	-613.5
Kheda	Available	525.8	978.2	724.4	742.7	1,048.50	803.5	776.9	1,146.30
	Required	-	1,254.00	1,396.70	1,653.50	1,721.00	1,795.50	1,877.90	1,969.10
	Balance	-	-275.9	-672.3	-910.8	-672.5	-992	-1,101.00	-822.8
Mehsana	Available	748.4	828	423.7	497.1	625.6	496.9	590.1	673.2
	Required	-	1,355.50	1,360.50	16,03.5	1,662.70	1,727.40	1,798.20	1,876.00
	Balance	-	-527.5	-936.9	1,106.40	-1,037.10	-1,230.50	-1,208.10	-1,202.80
Narmada	Available	-	-	32	123.1	112.8	120.9	100.9	143.5
	Required	-	338.8	414	350.6	339.9	330.5	322.3	315.5
	Balance	-	-	-382	-227.4	-227.1	-209.6	-221.4	-171.9
Navsari	Available	-	-	-	426.3	277.8	271.6	310.9	452.5
	Required	-	480.6	586.7	510.3	501.7	495.2	490.7	488.1
	Balance	-	-	-	-84.1	-223.9	-223.6	-179.8	-35.7
Panchmahals	Available	469.3	900.4	639	268.6	506.7	391.4	293.1	478.4
	Required	-	1,426.0	2,069.0	2175.8	2,183.7	2,195.3	2,210.6	2,229.9
	Balance	-	-525.6	-1,430.1	-1907.2	-1,677.0	-1,803.8	-1,917.5	-1,751.5
Patan	Available	-	-	81.3	280.3	364.9	313.7	323.6	464.2
	Required	-	840.3	695.8	997.6	1,074.10	1,158.70	1,252.40	1,356.20
	Balance	-	-	-614.6	-717.4	-709.2	-845	-928.9	-891.9
Porbandar	Available	-	-	-	273.6	278.9	308.7	245.4	336.4
	Required	-	321	362.8	373.7	376.9	381.1	386.3	392.3
	Balance	-	-	-	-100.1	-98	-72.4	-140.9	-55.9
Rajkot	Available	339.8	962.9	304.8	902.7	1,637.50	1,110.90	547.5	2,010.90
	Required	-	1,373.20	1,447.60	1579.8	1,606.90	1,638.80	1,676.00	1,719.00
	Balance	-	-410.3	-1,142.80	-677	30.7	-527.9	-1128.5	291.8

A. 4.4 continues....

Districts	Available/ Required/ Balance	Total Digestive Nutrient Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Sabarkantha	Available	535.4	782.9	473.3	769	990.8	729.2	721.6	1,184.20
	Required	-	2,041.20	2,483.90	2656.6	2,700.30	2,748.90	2,802.80	2,862.40
	Balance	-	-1,258.30	-2,010.60	-1887.6	-1,709.50	-2,019.80	-2,081.20	-1,678.20
Surat	Available	1,220.50	1,231.60	1,224.80	1366.7	597.3	480.7	480.8	523.1
	Required	-	-	1,646.10	1688.8	1,705.00	1,728.50	1,760.20	1,801.20
	Balance	-	-	-421.3	-322.1	-1,107.70	-1,247.80	-1,279.40	-1,278.10
Surendranagar	Available	237.4	362.8	282.4	439.2	541.8	442.6	336.7	618.8
	Required	-	-	940.6	1187.9	1,238.00	1,292.10	1,350.80	1,414.40
	Balance	-	-	-658.2	-748.7	-696.1	-849.5	-1014.1	-795.6
The Dangs	Available	42.8	61.1	67.4	98.4	104.4	107.4	85	111.9
	Required	-	-	192.3	161.1	155.2	150.2	145.9	142.6
	Balance	-	-	-124.9	-62.8	-50.9	-42.8	-61	-30.6
Vadodara	Available	365.6	488.2	414.4	474.9	616.3	559.8	446.7	886.4
	Required	-	-	1,640.60	1779.8	1,810.10	1,844.30	1,882.90	1,926.70
	Balance	-	-	-1,226.20	-1304.9	-1,193.80	-1,284.50	-1,436.20	-1,040.30
Valsad	Available		669.5	567.5	336.3	274.4	274.9	247.8	300.3
	Required		-	589.3	729.2	763.3	802.8	849	902.9
	Balance		-	-21.8	-392.9	-488.9	-527.9	-601.1	-602.6

A. 4.5: Details of Feed Consumption in Gujarat- Cattle

Cattle	Year	Green Fodder				Dry Fodder				Concentrate			
		S	M	W	All	S	M	W	All	S	M	W	All
In-milk	1997-98	8.9	13	10.2	10.7	10.7	7.5	10.9	9.7	2	2.2	2.2	2.1
	2003-04	9.2	11.1	10.5	10.3	10.3	7.2	10.3	9.3	1.9	2.1	2	2
	2006-07	9.7	12.5	10.3	10.8	11	6.8	9.3	9	2.1	2.2	2.4	2.2
	2007-08	6.7	12.2	10.8	9.9	10.7	7.5	9.5	9.2	2.2	2.3	2.3	2.3
	2008-09	11.1	11.1	11.2	11.1	9.8	9.1	9.1	9.3	2.3	2.6	2.5	2.5
	2009-10	10.3	11.3	11	10.9	11	15.9	9.7	12.2	2.6	2.5	2.5	2.5
	2010-11	10.3	12.4	11.8	11.5	11	7.4	9.7	9.3	2.3	2.6	2.8	2.6
2011-12	9.8	11.8	10.1	10.6	10.2	8	9.3	9.1	2.6	2.5	2.8	2.7	
Dry & Not Calved Even Once	1997-98	6.5	11.2	6.9	8.2	8.6	5.8	8.5	7.6	2.9	1.5	1.5	2
	2003-04	7.4	7.8	6.9	7.4	7.4	5.3	7.7	6.8	1.5	1.3	1.5	1.4
	2006-07	6.1	8.4	7.9	7.5	8.3	5.3	8	7.2	1.8	1.2	4.9	2.6
	2007-08	7.7	9	7	7.9	8.7	6	7.7	7.5	1.3	1.3	3	1.9
	2008-09	8.8	9	8.1	8.6	8.6	6.8	7.8	7.8	2	1.3	1.4	1.5
	2009-10	8.1	8.7	8	8.3	9	6.7	8.4	8	2.4	1.9	3.6	2.6
	2010-11	7.8	9.1	8.3	8.4	9.1	6.3	8.4	7.9	1.7	2.1	1.9	1.9
2011-12	7.2	9.5	7.3	8	8.7	6.6	8.6	8	2	2.3	3.1	2.4	
Young	1997-98	2.9	4.4	2.9	3.4	4.3	2.5	3.5	3.4	0	0.5	0.5	0.3
	2003-04	2.9	3.4	3.1	3.1	3	2.5	2.6	2.7	0	0	1	0.3
	2006-07	2.9	3.8	3.2	3.3	3.4	2.5	3.3	3.1		1.7	0.6	1.2
	2007-08	2.9	3.4	3.1	3.1	3.3	2.4	3	2.9	0.5	0.7	0	0.4
	2008-09	3.1	3.2	3	3.1	3.3	2.6	3	2.9	0	2.4	3	1.8
	2009-10	3.6	3.5	3.1	3.4	3.3	2.7	3.2	3	4.5	1.8	1.3	2.5
	2010-11	3.1	3.5	3.2	3.3	3.6	2.6	3.4	3.2	0	0.6	2	0.9
2011-12	2.8	3.7	3.2	3.3	3.4	2.6	3.2	3.1	0.5	0.5	1	0.7	
Adult Male	1997-98	7.8	13.4	8.9	10	11.2	4.4	10.5	8.7	1.7	2	2	1.9
	2003-04	7.7	12	10.5	10.1	11.2	8.2	10.7	10	4.5	2	1.4	2.6
	2006-07	8.5	11.8	9.4	9.9	11.2	7	11	9.7	1.8	3.1	1.5	2.1
	2007-08	9.8	10.3	9.1	9.7	11.4	7.7	13.1	10.7	1.6	1.9	1.5	1.7
	2008-09	11.7	12.7	9.8	11.4	11.3	8.4	9.4	9.7	1.5	2.3	2.1	1.9
	2009-10	9.2	12.2	11.1	10.8	11.3	8.2	10.8	10.1	1	2.4	1.9	1.8
	2010-11	7.6	13	9.8	10.1	11.8	8	11.4	10.4	1.4	2.2	1.9	1.8
2011-12	8.3	12	7.8	9.4	10.9	8.3	10.6	9.9	2.8	2.4	1.8	2.3	

Note: S-Summer, M- Monsoon and W- Winter

Source: Survey Reports on estimates of major livestock products, Directorate of Animal Husbandry, Gujarat State, Gandhinagar.

A. 4.6: Details of Feed Consumption in Gujarat – Buffalo

Cattle	Year	Green Fodder				Dry Fodder				Concentrate			
		S	M	W	All	S	M	W	All	S	M	W	All
In-milk	1997-98	9.3	14	10.8	11.4	11	7.3	11.4	9.9	2.4	3.1	3.5	3
	2003-04	10.4	13.7	11.1	11.7	10.7	7.4	10.3	9.5	2.1	2.4	2.4	2.3
	2006-07	10.6	13.7	10.3	11.5	11.5	7	10.1	9.5	2.5	2.4	2.5	2.5
	2007-08	12.2	13.7	11.6	12.5	11.8	7.6	9.6	9.7	2.5	2.4	2.5	2.5
	2008-09	11.8	12	11.4	11.7	11.4	8.4	9.9	9.9	2.6	2.6	3.2	2.8
	2009-10	10.9	12.8	11.8	11.8	11.1	8.5	9.5	9.7	2.7	2.8	2.7	2.7
	2010-11	10.4	12.9	10.8	11.3	10.6	7.4	9.6	9.2	2.5	2.6	3	2.7
2011-12	10.5	13	10.7	11.4	10.6	8.6	11.1	10.1	2.6	2.7	2.8	2.7	
Dry & Not Calved Even Once	1997-98	6.2	10.9	7	8	8.8	5.4	9.2	7.8	1.9	1.5	2.6	2
	2003-04	8.1	9.7	8.2	8.7	9.1	5.6	11	8.6	2.1	1.7	1.7	1.8
	2006-07	6.7	9.6	7.7	8	8.5	4.8	7.2	6.8	1.6	2.6	1.3	1.8
	2007-08	8.9	10	8.3	9.1	9	6.1	8.1	7.7	1.4	2.3	1.2	1.6
	2008-09	9.5	10.7	8.8	9.7	8.7	9.7	8.3	8.9	3.8	4	2.5	3.5
	2009-10	8.7	9.9	9.3	9.3	8.9	6.6	7.9	7.8	2.3	4.1	2.5	3
	2010-11	7.4	9.6	8.2	8.4	8.9	5.9	7.9	7.6	2.5	2.9	2.9	2.8
2011-12	7.4	10.1	8	8.5	8.9	6.7	9	8.2	2.2	3.9	2.1	2.7	
Young	1997-98	2.9	4.4	2.9	3.4	4.3	2.5	3.5	3.4	0	0.5	0.5	0.3
	2003-04	2.9	3.4	3.1	3.1	3	2.5	2.6	2.7	0	0	1	0.3
	2006-07	2.9	3.8	3.2	3.3	3.4	2.5	3.3	3.1		1.7	0.6	1.2
	2007-08	2.9	3.4	3.1	3.1	3.3	2.4	3	2.9	0.5	0.7	0	0.4
	2008-09	3.1	3.2	3	3.1	3.3	2.6	3	2.9	0	2.4	3	1.8
	2009-10	3.6	3.5	3.1	3.4	3.3	2.7	3.2	3	4.5	1.8	1.3	2.5
	2010-11	3.1	3.5	3.2	3.3	3.6	2.6	3.4	3.2	0	0.6	2	0.9
2011-12	2.8	3.7	3.2	3.3	3.4	2.6	3.2	3.1	0.5	0.5	1	0.7	
Adult Male	1997-98	7.8	13.4	8.9	10	11.2	4.4	10.5	8.7	1.7	2	2	1.9
	2003-04	7.7	12	10.5	10.1	11.2	8.2	10.7	10	4.5	2	1.4	2.6
	2006-07	8.5	11.8	9.4	9.9	11.2	7	11	9.7	1.8	3.1	1.5	2.1
	2007-08	9.8	10.3	9.1	9.7	11.4	7.7	13.1	10.7	1.6	1.9	1.5	1.7
	2008-09	11.7	12.7	9.8	11.4	11.3	8.4	9.4	9.7	1.5	2.3	2.1	1.9
	2009-10	9.2	12.2	11.1	10.8	11.3	8.2	10.8	10.1	1	2.4	1.9	1.8
	2010-11	7.6	13	9.8	10.1	11.8	8	11.4	10.4	1.4	2.2	1.9	1.8
2011-12	8.3	12	7.8	9.4	10.9	8.3	10.6	9.9	2.8	2.4	1.8	2.3	

Note: S-Summer, M- Monsoon and W- Winter

Source: Survey Reports on estimates of major livestock products, Directorate of Animal Husbandry, Gujarat State, Gandhinagar.

Appendix I

Comments on the Draft Report received from
Agricultural Development and Rural Transformation Centre, Institute for Social and
Economic Change, Bangalore, Karnataka

Comments on draft report

- | | | |
|----|---|---|
| 1. | Title of report | Assessment of Livestock Feed and Fodder in Gujarat |
| 2. | Date of receipt of the Draft report | 23 March 2020 |
| 3. | Date of dispatch of the comments | 30 March 2020 |
| 4. | Comments on the Objectives of the study | : As we finalized during the workshop you have covered all the objectives that required for the study. |
| 5. | Comments on the methodology | Methodology followed in the study was good enough to justify the objectives of the study |
| 6. | Comments on analysis, organization, presentation etc. | In first chapter you have covered entire scenario of animal husbandry of India, dairy development, feed & fodder status, along with literature. In second chapter you have covered entire scenario of livestock in Rajasthan state. The overall analysis, chapter organization and presentation were very good and justified for the objectives that we are framed. |
| 7. | References: | The references are good enough |
| 8. | General remarks: | You have done excellent work that will very much helpful to write all India report |
| 9. | Overall view on acceptability of report: The entire report you done is covered all the things that we decided at the time of workshop, the report is accepted sir, and it will very good base to write all India report. Thank you sir for such a wonderful report. | |

Appendix II

Action taken by the authors based on the comments received

- As per the evaluation report, no action is required.

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