

Assessment of Livestock Feed and Fodder in Rajasthan

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Foreword

Rajasthan is rich in agro-ecological diversity and has a wide range of unique livestock production systems that have evolved in different regions in tune with the naturally available resources and needs of the people. This diversity begins with the choice of species reared; breeds that have evolved, management and feeding practices, health care systems that are closely linked to the natural flora and fauna, and local marketing systems. Animal Husbandry in Rajasthan is a major economic activity contributing approximately 10.21 per cent to the total GDP of the state. Agriculture and dairying have always been inter-dependent in the state. The cultivator depends largely on bullock power for tillage, irrigation and carting. Milk and milk products constitute the only source of animal protein for a sizable vegetarian population. Milk is also an item of cultural importance. Milk products are an integral constituent of religious ceremonies. As per the livestock census of 2012, there were 577.32 lakh animals in the State. Rajasthan accounts for around 7 per cent of the country's cattle population while contributes about 11 per cent of the total milk production. Besides, State contributes about 30 per cent of the mutton and 31 per cent wool produced in the country. Rajasthan rank first in wool production while second in milk production. The state has three native cattle breeds, viz. Rathi, Tharparker and Nagori, having great deal of endurance. Rathi cattle breed is reared for dairy purposes in the northern districts of Shri Ganganagar, Bikaner and parts of Jaisalmer which are irrigated or partially irrigated arid zones with alluvial or loamy soil. The Tharparkar cattle breed is native of the Jodhpur and Jaisalmer districts in eastern region of the state which has arid climate characterized by low rainfall and desert soil.

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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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 Rajasthan

H. Sharma, S. S. Kalamkar & T. Parihar¹

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 10 years to 7.8 million tonnes in the next 8 years (total 210 million by 2021-22). To meet

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

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. Ajmer, Barmer and Udaipur represents three regions of the state viz. Central, West and South as well as three different ACZs of the state viz. IIA& IIB; IA; and IVA of the state. The reference period of the study was 2019-20 agricultural year.

4. About Study Area:

Rajasthan is the largest state having about 10.41 percent of the total geographical area of the country. It supports 5.5 percent of human population and about 11 percent of the country's livestock population. Agriculture and allied activities, however, remain the primary and major economic activity in the state providing livelihood to 66 percent of the state's population. Because of the limited water resources, most of the agriculture production is rain-fed and thus, the livestock sector assumes more importance. Animal husbandry is not only a subsidiary occupation to agriculture but it is a major economic activity, especially in the arid and semi-arid regions of the Rajasthan. Livestock sector development has a significant positive impact in generating employment and reducing poverty in rural areas.

Rajasthan is rich in agro-ecological diversity and has a wide range of unique livestock production systems that have evolved in different regions in accordance with the naturally available resources and needs of the people. This diversity is associated with the choice of species reared; breeds that have evolved, management and feeding practices, health care systems that are closely linked to the natural flora and fauna, and local marketing systems. Development of livestock sector therefore is a critical pathway to rural prosperity. This fact in context to Rajasthan is well established where agricultural operations offer less promising prospects due to extreme geo-climatic conditions and uncertainty of rains. As such livestock operations have expressed their superiority over crop farming in terms of growth, stability, resource conservation and uplifting the socio-economic status of the inhabitants.

Animal husbandry and livestock sector contribute a lot in state economy, and has particularly great potential in rural area. The potential of crop production depends upon huge investment, weather and meteorological conditions. In contrast, animal husbandry and livestock is more stable and requires lesser investments. Livestock and poultry have proved to be life saviour in many distressed conditions, especially in case of drought. The livestock population of the state was 577.32 lakh (2012). Rajasthan is considered as 'Denmark of India'. The total milk production in Rajasthan was 22.43 million tonnes in 2017-18, and ranked second in India. Animal husbandry is a major economic activity contributing

approximately 11.19 percent to the total GSDP of the state in 2018-19. The contribution of agriculture and livestock to total GSDP was estimated to be 35.38 percent, while contribution of livestock to agriculture and livestock together was around 32 percent. Thus, one third of the agriculture sector output comes from livestock sector. The share of GVA from livestock to agriculture sector and livestock has been fluctuating over the period of last more than one and half decade and remains between 20-32 percent. However, the contribution of Gross Value Added from agriculture and livestock to total GSDP has increased from 34.55 percent in 2011-12 to 35.38 percent in 2018-19. Rajasthan accounted for 12.97 percent share in value of output from milk (at current prices) in the country during 2015-16, while its share was 11.15 percent in total value of output from livestock in the country during 2015-16 (GOI, 2018, GSDP).

The state of Rajasthan is rich in livestock wealth. State is blessed with the best breeds of cattle, sheep and camels in the country. The climatic conditions are adverse with scarcity of water for irrigation and erratic rains with very low average annual rainfall. These conditions leave a little scope for crop production and enhance the importance of animal husbandry over the crop production especially during recurrent droughts. The Nineteenth Livestock Census (2012) of India placed total livestock population at 512.1 million, out of which, 57.73 million livestock (11.3 percent) population was in the state of Rajasthan. The state accounted for 6.98 percent share in cattle population, 11.94 percent of buffalo population, 13.95 percent sheep population and 16.03 percent goat population of the country. The district-wise share in total state livestock population figures indicate that Barmer district (9.30 percent) had the highest number of livestock population followed by Jodhpur, Jaisalmer, Nagour, Jaipur, Udaipur, Bikaner, Bhilwara and Pali. These nine districts together accounted for 49.21 percent of total livestock population in the state. Jaipur district had the highest number of in-milk crossbreds and buffaloes. Bikaner had the highest number of in-milk indigenous cattle followed by Jodhpur and Barmer district. In milk indigenous cattle like Tharparkar cattle breed is native of Jodhpur and Jaisalmer districts in eastern region of Rajasthan whereas Rathi cattle breed is reared for dairy purposes in the northern districts of Shri Ganganagar, Bikaner and parts of Jaisalmer which are irrigated or partially irrigated arid zones. The highest livestock and bovine animal density was recorded in Bharatpur.

Rajasthan ranks second among the milk producing states in India, achieving 224.27 lakh MT in 2017-18, which has increased from the 41.46 lakh MT during 1985-86. A numbers of initiatives were taken by the government which could help in improving the milk productivity over the period. 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 against the estimated animals' requirements, feed resources available in Rajasthan are lower. It is estimated that against the requirement of 375 lakh MT of dry fodder, state availability was of 368 lakh MT of dry fodder. It can be seen that during the last two decade (1992 to 2011), shortage of dry matter in the State increased from 29.01 percent of the requirement to 51.88 percent during corresponding years.

In Rajasthan, the livestock keepers have traditionally relied on common grazing lands "gochars", scared groves "orans" and forests. With the growth of mining industry and allocation of community wastelands for biodiesel plantation, the permanent pastures and other grazing land has reduced from 1.9 million ha in 1990-91 to 1.7 million ha in 2009-10. Often layers of white marble dust choke neighbouring grazing land. Rajasthan is a leader in crops like sorghum, pearl millet (bajra), pulses, oil seeds, wheat and rice, all of which in some way or other, form parts of compound livestock feed. Rajasthan also produces non-

conventional ingredients, which can be integral part of the feed raw material. Now the dairy farmers are shifting from extensive open grazing system to semi-intensive and intensive stall feeding system. Green fodder is a comparatively economical source of nutrients. However, the availability of green fodder is lower than estimated requirement. In Rajasthan, the area under fodder crop to state gross cropped area increased from 15.93 percent in 2008-09 to 20.26 percent in 2012-13. Bikaner District had the highest area under fodder crops followed by Churu, Hanumangarh and Jaisalmer District.

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 47 years of which almost one third 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 62 per cent were from backward classes, followed by around 18 per cent from open category, 15 per cent from Scheduled tribe and rest of them were from Schedules Tribe. Most of the selected households respondents were male (93 per cent) and very few (7 per cent) were female respondents.
- The selected households had slightly higher experience in farming business (23 years) followed by dairy (22 years) and sheep and goat rearing (11 years). The average family size was found to be 6.7 persons and the highest share of family members were found to be primarily engaged in farming business (39 per cent) followed by 36 per cent in dairy 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 82 per cent households followed by animal husbandry and dairy (13 per cent) and very meagre share of household 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. 135559/- followed by Rs. 48640/- from dairy, Rs 10102/- from sheep and goat rearing. Around 71 per cent of the selected households were found to be a no association with any social and cooperative organisations.
- On an average, operational land holdings was estimated to be small to medium size of holdings having 2.12 ha of which 82 per cent land was irrigated. It was very surprising and pleasant to note that almost 19 per cent of total operational holdings was devoted to fodder crops, while same was slightly higher in case of land under irrigated condition (19 per cent) as compared to 18 per cent land was under fodder by rainfed land holders. The groundwater the main source of irrigation (more than 7 per cent) 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 lucerne were grown. The fodder cultivation is found to be relatively profitable than other crops.
- The details on fodder and feed fed to the animals indicate that the more than 94 per cent selected buffalo and Cattle had average age of more than 2 years while around three fifth of sheet and goats were of same age. The average value of sheet for the age of 2 years and above ranges between as high as around Rs. 8167 in Udaipur and as lowest as Rs. 7100/- in Barmer district while same was for goat of Rs. Rs.6993/- in Barmer and Rs. 5769 in Ajmer district, respectively.

- The average value of the buffalo, crossbred cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 50000/- , followed by Rs. 44000/- for crossbred cattle and Rs. 32000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Ajmer district.
- 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 10- 12 kg of green of fodder followed by 8-11 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 4-7 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 137795 tonnes of green fodder, 132525 tones of dry fodder and 14552 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 Rajasthan for the year 2016-17 and was estimated to be 225638 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 severely deficit in green fodder followed by availability of concentrates. The dry fodder availability is relatively better but shot of around 12 per cent of actual requirement.
- The major sources of livestock feed reported by the sample households are crop residues was major source of the livestock feed followed by tree legumes. Half of the respondents depend on the improved forage and pastures, household left over. Very few household have reported use of grazing land and 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 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 crossbred cattle (9.52 lit/day) followed 7.15 lit/day from buffalo and 5.83 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be around half 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 constraints faced as expected were non availability of adequate irrigation water, high cost of cultivation/production and low return on fodder production, poor Livestock extension services, land is very less therefore cannot afford to put more land under fodder seed/crop production and High cost of fodder seed. The other major constraints reported are non availability of labour and no provision of quality seed by society on credit and non availability of quality fodder seed in market.

- The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be used 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, none of the household had 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 (28 per cent), followed by considered it inferior in comparison to fresh one (28 per cent); lack of awareness on production and post harvest management (26 per cent) and more laborious (18 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 facilities, Mineral Mixture, fodder seed while one each household had received support of cattle shed subsidy and seed distribution kit. Around 96 percent of households reported that they did not received any support from the government net or dairy. The top two suggestions made by the selected households were Green Fodder bank should be provided by Govt and Need irrigation facility, while 86 per cent households did not provide any suggestion.

6.Conclusions and Policy Recommendations:

- Animal husbandry and livestock sector contribute a lot in state economy, and has particularly great potential in rural area. The potential of crop production depends upon huge investment, weather and meteorological conditions. In contrast, animal husbandry and livestock is more stable and requires lesser investments. Animal husbandry contributed over 11 percent to the Gross State Domestic Product. More than 80 percent rural families keep livestock in their households. About 35 percent of the income of small and marginal farmers came from dairy and animal husbandry. In arid areas, the contribution was as high as 50 percent. The sector has potential to create employment in rural areas with least investments as compared to other sectors. Milk contributed to around 28 percent to the agricultural GDP of Rajasthan 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.
- There is a lack of adequate and genuine data on production and availability of various types of fodder and feed grains. Therefore, competent agencies should be encouraged to generate real time and time-period data on fodder production, feed grain production, land availability for grassland and other pasture grounds, etc. Existing networks involved in data collection for cost of cultivation and other such established sources should be engaged and expanded to collect such real time information as well.
- The fodder crop cultivation was estimated to be more profitable as compared to other competitive or cereals crops grown during kharif and rabi seasons. Therefore, milk union and PDCS need to give more attention of fodder development program.
- Shortage of quality fodder and feed is another major constraint for dairy development. The gap between the requirement and availability of feed and fodder is increasing due to increasing livestock population as against decreasing area under fodder cultivation and reduced availability of crop residues as fodder. Besides common property resources are continuously shrinking due to over grazing of the existing grass land. Therefore, there is a need to frame strategies for sufficient availability of good quality

feed and fodder for efficient utilisation of genetic potential of the various livestock species and thereby sustainable improvement in productivity.

- Fodder based cheaper feeding strategies are required to reduce the cost of production of quality livestock since feed alone constitutes 70 percent of milk production cost. To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry crop residues and feed need to be met by either increasing productivity, utilising untapped feed resources, increasing land under fodder cultivation. In parallel, appropriate veterinary research regarding the sources of cost-effective nutritious feed should also be encouraged, tested and informed to the farmers.
- Due to inadequate rainfall during rainy season, the quality and quantity of fodder production gets affected. Thus, there is a need to develop fodder varieties suitable to agro-climatic conditions of the area.
- Efforts need to be made to increase production of quality fodder seeds through necessary incentives, arranging foundation seeds of different high yielding fodder varieties and modern scientific farming procedures. Accordingly more seed plants should be established and farmers should be incentivized and trained to participate in such programmes.
- Efforts are required to increase area under fodder cultivation, especially through use of barren and fallow lands and silviculture. Appropriate resources and technologies need to be made available to ensure quality fodder seed production. Fodder cultivation in degraded land and forest land need to be taken wherever possible with the help of farming community. Round the year availability of quality fodder through promotion of hay, silage and fodder banks, need to be emphasised. Non conventional sources of feeds such as azolla, processed vegetables and fruits waste, etc need to be promoted.
- While fertile lands with assured irrigation are diverted for growing high value crops, large stretches of marginal and wastelands are lying under-utilised across the country. There are also opportunities to introduce fodder as an intercrop or as a soil binder under the watershed development programme.
- Most of the fodder varieties presently released for cultivation, are not the most ideal for cultivation on such low productive lands. Identification of suitable fodder species for such areas and developing suitable cultivation practices are necessary to boost fodder production on marginal and wastelands in the future.
- The role of institutions in fodder development especially district dairy cooperatives needs to be strengthened and there should be dedicated fodder officer to take up fodder development activity on large scale.
- Cultivation of fodder crop is not considered as main/ regular crop and therefore fodder crop mostly receives less coverage and attention in allotment of land. It is thus mostly grown on waste/inferior soil or sometime on bunds and field boundary. Farmers should be explained the benefits of growing fodder seed and fodder. Financial benefits of producing fodder and fodder seed should be explained to farmers and can be demonstrated with the help of some voluntary motivated farmer.
- It was observed that a fodder market has been working in Kota city for fodder growers and fodder consumers, whereas good number of marginal as well as small farmers or fodder growers participated and earned a lot of income from fodder cultivation. This kind of market should be developed at other places which have fodder shortage or are under developed area with regards to fodder cultivation. The supply channels should also be extended.
- During our field visits at the selected study area, we observed that some of the fodder growers had cultivated efficiently the fodder crop and they had keen interest for the

fodder seed cultivation which are specially grown in these area. Such good results were observed because some special variety of fodder had been cultivated in this area and had also provided higher yield.

- Also the support for fodder storage needs to be provided to fodder growers to minimize the fodder losses and to assure timely availability of the same even during off-season.
- Rajasthan is already bestowed with crucial favourable factors related to animal husbandary and dairy business in the form of ownership of huge number of live stock and many of them are high in endurance. Livestock owners face challenges in the form of harsh climate, difficult arid desert topography, scanty rainfall and fierce summers, scarcity of water for irrigation, among others. However, the courageous farmers can perform very well in terms of producing high yields in dairy business with the support of dairy unions and PDCS.

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 insurance. It has been witnessed over the years that the stability in dairy income is far

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

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 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.

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).

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

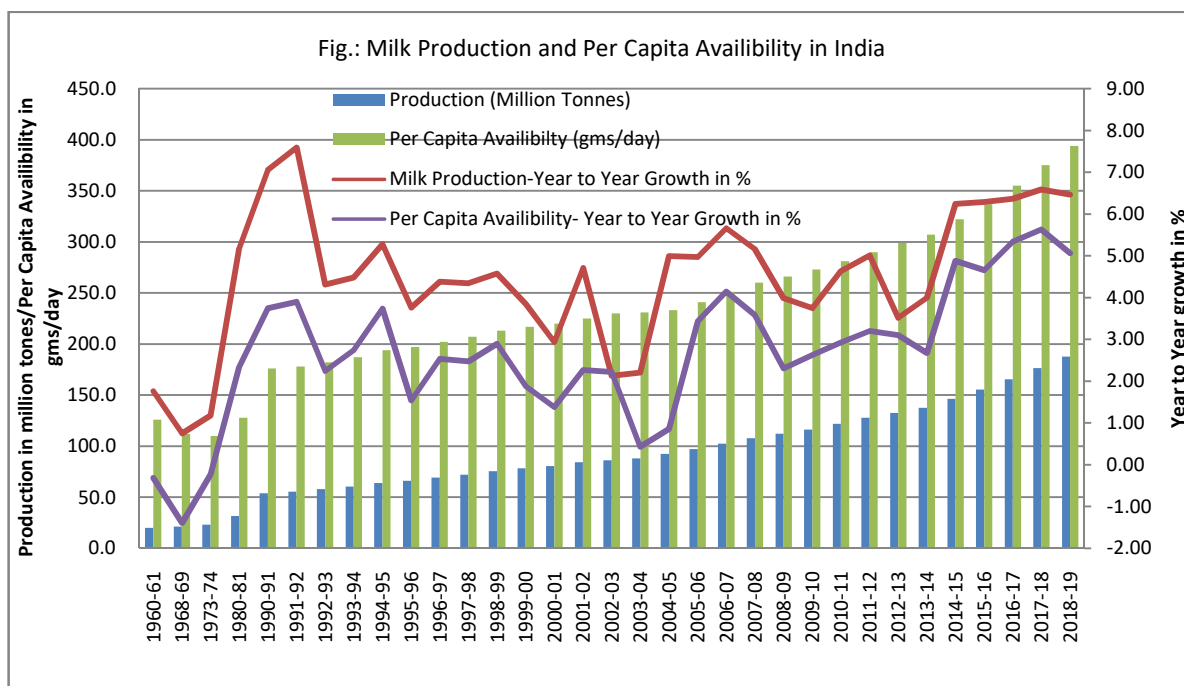
Category of Land Holdings	Distribution of Livestock (%)	Per Cent of Holding	Cattle & Buffalo per holding (Nos)
Marginal (Below 1.00 ha)	36.9	57.1	1.9
Small (1.00 to 1.99 ha)	23.5	20.3	3.6
Semi-medium (2.00 to 3.99 ha)	20.2	13.7	4.8
Medium (4.00 to 9.99 ha)	14.7	7.3	6.7
Large (10.00 ha & above)	4.8	1.6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

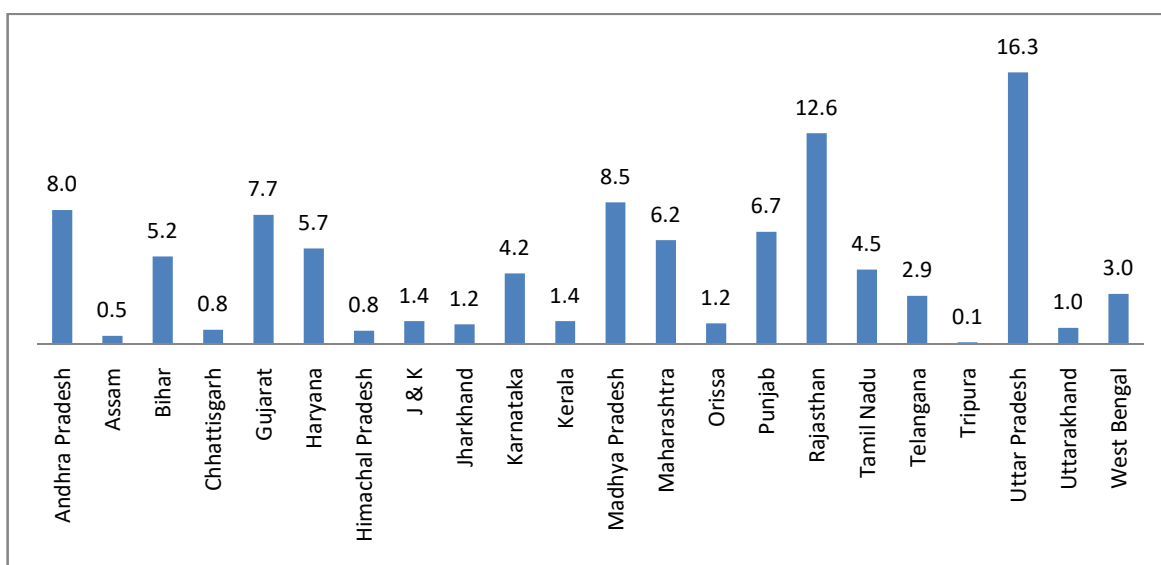
Eastern regions of the country need special attention as these states seem to be lagging behind dairying states such as Punjab, Gujarat and Karnataka (Kumar, 2016). Bihar (5.2 per cent) in the eastern region and Sikkim, Arunachal Pradesh, Tripura and Mizoram in the North Eastern region did not perform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

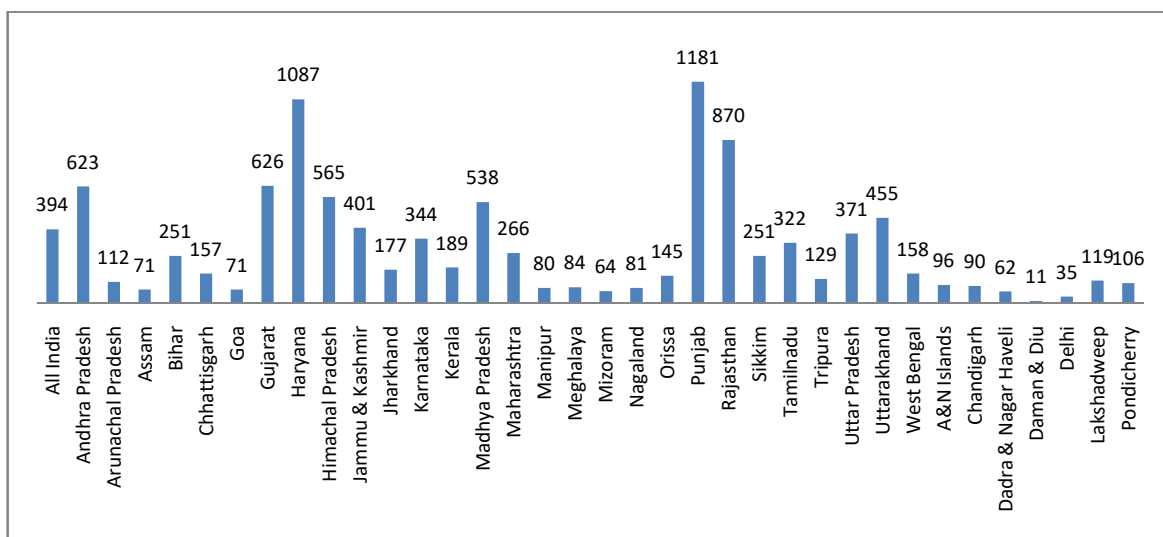


Source: <https://www.nddb.coop/information/stats>

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/>

Inspite 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	2.78	10258	3.12

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 (million tonnes)								
	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 (million tonnes)		Demand (million tonnes)		Deficits (million tonnes)		Deficits as a % of demand (million tonnes)	
	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 (Figures in million tonnes)					
	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 (million tonnes)				
	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
Manipur	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/O8data/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 proper seed chain. Only few public sector agencies like Indian Grassland and

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.

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 polypachya</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 which has the potential of meeting fodder requirements during season and off-

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

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) studied the economics of fodder cultivation, processing of forages and its marketing

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/>

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 weight 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 for 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 versus 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 (NDDDB, 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 Rajasthan.

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 Rajasthan, Jaipur. 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, i.e. Barmer, Jodhpur and Udaipur. 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 are 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

$$Y_t = Y_0 \cdot (1+r)^t$$

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:

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:

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

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

Hlij 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 Rajasthan. For the study, districts were selected based on the Livestock population from the available secondary data. The

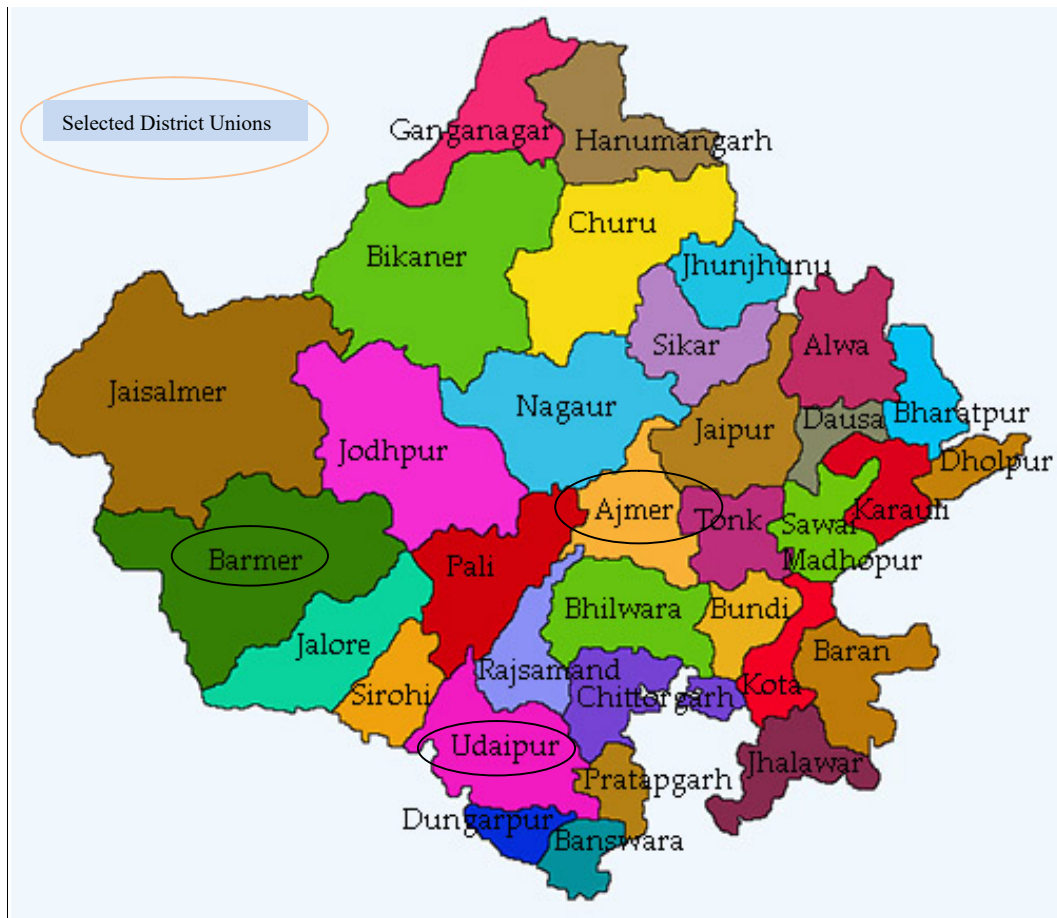
proportionate sampling technique was applied to select the sample districts in selected states. To select districts for the study, districtwise animal population was complained. Based on the size of the population of Cattle, Buffalo Sheep and Goats ranks had been given to individual districts and then average of the obtained ranks of individual district was considered. The selected three districts (Ajmer, Barmer and Udaipur) represents the of the state viz. Central, West and South region of Rajasthan. 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 Rajasthan 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 at

Sl	District	Taluk	Village	Selected HH			ALL HH		
				B	C	SG	T	(Multiple)	
1	Ajmer	Ajmer	Sardhana	17	11	15	43	19	
			Beaware	Gohana	2	0	3	5	3
				Thikrana	3	2	1	6	3
			Kishangarh	BhuhadaKishangarh	2	1	1	4	2
				Kachariya	1	1	1	3	1
				Kishangarh	0	1	1	2	1
				Madana	2	1	2	5	2
				Raghunathpur	2	2	1	5	2
		Total	29	19	25	73	33		
2	Barmer	Balotra	Ashodara	35	31	25	91	43	
			Chottan	Kaprao	12	24	22	58	24
			Gudamalani	Peeprali	10	9	8	27	11
				Piprali	9	11	8	28	13
					66	75	63	204	91
3	Udaipur	Girwa	Thoor	10	13	7	30	15	
			Jhadol	Gogala	7	11	5	23	12
				Gogla	12	19	7	38	19
			Kotra	Sulav	12	14	15	41	16
				Total	41	57	34	132	62
	Grand Total			136	151	122	409	186	

Notes: B- Buffalo; C-Cattle; S-Sheep and G- Goat.

Map 1.1: Location Map of Study Area in Rajasthan, 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 Rajasthan. 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 Rajasthan

2.1 Introduction:

Rajasthan is the largest state of India located in north-west region, with a land area of 34.3 million hectares (10.4 percent of India's total area). The state has four main physiographical regions- the Western Desert, the Aravali hills (located southwest to northeast), the Eastern Plain, and the South Eastern Plateau. It is divided into 33 districts, and further sub-divided into 249 blocks and 9,177 gram panchayats. The total human population of Rajasthan in 2011 was 68.62 million, of which 75.3 percent was rural population. The population density was estimated to be 201 per sq. km. The state has experienced a decadal population growth rate of 21.44 percent (2011 over 2001), which is higher than not only national average (17.64 percent) but also highest among the states in the country. An estimated 24.8 percent of the population lives below poverty line (BPL), compared to 29.8 percent at national level. Between 2011-12 and 2018-19, Gross State Domestic Product (GSDP) expanded at a Compound Annual Growth Rate (CAGR) of 11.37 percent (in Rupee terms) to US\$ 128.10 billion¹ whereas the Net State Domestic Product (NSDP) expanded at a CAGR of 11.19 percent (in Rupee terms) to US\$ 115.13 billion.

Rajasthan is the largest state having about 10.41 percent of the total geographical area of the country. It supports 5.5 percent of human population and about 11 percent of the country's livestock population. Agriculture and allied activities, however, remain the primary and major economic activity in the state providing livelihood to 66 percent of the state's population. Because of the limited water resources, most of the agriculture production is rain-fed and thus, the livestock sector assumes more importance. Animal husbandry is not only a subsidiary occupation to agriculture but it is a major economic activity, especially in the arid and semi-arid regions of the Rajasthan. Livestock sector development has a significant positive impact in generating employment and reducing poverty in rural areas.

¹ <https://www.ibef.org/states/rajasthan-presentation>

2.2 Role of Dairy Sector in State Economy of Rajasthan:

Rajasthan is rich in agro-ecological diversity and has a wide range of unique livestock production systems that have evolved in different regions in accordance with the naturally available resources and needs of the people. This diversity is associated with the choice of species reared; breeds that have evolved, management and feeding practices, health care systems that are closely linked to the natural flora and fauna, and local marketing systems. Development of livestock sector therefore is a critical pathway to rural prosperity. This fact in context to Rajasthan is well established where agricultural operations offer less promising prospects due to extreme geo-climatic conditions and uncertainty of rains. As such livestock operations have expressed their superiority over crop farming in terms of growth, stability, resource conservation and uplifting the socio- economic status of the inhabitants.

Animal husbandry and livestock sector contribute a lot in state economy, and has particularly great potential in rural area. The potential of crop production depends upon huge investment, weather and meteorological conditions. In contrast, animal husbandry and livestock is more stable and requires lesser investments. Livestock and poultry have proved to be life saviour in many distressed conditions, especially in case of drought. The livestock population of the state was 577.32 lakh (2012). Rajasthan is considered as 'Denmark of India'. The total milk production in Rajasthan was 22.43 million tonnes in 2017-18, and ranked second in India. Animal husbandry is a major economic activity contributing approximately 11.19 percent to the total GSDP of the state in 2018-19. The contribution of agriculture and livestock to total GSDP was estimated to be 35.38 percent, while contribution of livestock to agriculture and livestock together was around 32 percent. Thus, one third of the agriculture sector output comes from livestock sector (Table 2.1). The share of GVA from livestock to agriculture sector and livestock has been fluctuating over the period of last more than one and half decade and remains between 20-32 percent. However, the contribution of Gross Value Added from agriculture and livestock to total GSDP has increased from 34.55 percent in 2011-12 to 35.38 percent in 2018-19. Rajasthan accounted for 12.97 percent share in value of output from milk (at current prices) in the country during 2015-16, while its share was 11.15 percent in total value of output from livestock in the country during 2015-16 (GOI, 2018, GSDP).

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

Sr. No.	Year	Total GSDP (Rs In Crores)	Contribution of GVA from Agriculture to Total GSDP (%)	Contribution of GVA from Livestock to Total GSDP (%)	Contribution of GVA from Agriculture & Livestock to Total GSDP (%)	Contribution of GVA from Agriculture & Livestock to Total GSVA (%)	Contribution of GVA from Livestock to GVA from Agriculture and Livestock
1	2011-12	434837	27.39	7.16	34.55	36.03	20.72
2	2012-13	493551	27.64	7.28	34.92	36.51	20.84
3	2013-14	551031	26.82	7.53	34.35	36.17	21.92
4	2014-15	615642	24.86	8.66	33.52	35.36	25.84
5	2015-16	681704	24.61	9.32	33.92	35.95	27.47
6	2016-17	743646	24.43	9.37	33.80	35.56	27.73
7	2017-18	823291	23.96	10.69	34.65	36.48	30.87
8	2018-19	924251	24.19	11.19	35.38	37.36	31.63

Source: mospi.nic.in/sites/default/files/press_releases_statements/Rajasthan.xlsx

Table 2.2: Value of Output: Agriculture and Livestock

Item	Value of Output: Agriculture and Livestock in Rajasthan						
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Value of Output at Current Prices (Rs. billion)							
Agriculture & Allied*	489	521	615	677	819	897	1,187
Agriculture	265	280	338	384	444	435	636
Livestock	167	177	198	220	289	345	418
Share of Value of Output to Agriculture and Allied* (%)							
Agriculture	54	54	55	57	54	48	54
Livestock	34	34	32	32	35	38	35
Value of Output at Constant Prices (Rs. billion) (2004-05)							
Agriculture & Allied*	489	488	521	534	577	538	643
Agriculture	265	259	280	287	307	252	342
Livestock	167	173	183	186	217	225	239
Share of Value of Output to Agriculture and Allied* (%)							
Agriculture	54	53	54	54	53	47	53
Livestock	34	35	35	35	38	42	37
Value of Livestock Output at Current Prices (Rs. billion)							
Milk	114	122	138	152	211	250	308
Meat	8	10	10	12	14	16	18
Egg	1	1	1	1	1	2	2
Dung	39	39	42	46	53	63	73
Others^	5	5	7	9	10	14	17
Share of Livestock Output at Current Prices (%)							
Milk	68	69	70	69	73	72	74
Meat	5	6	5	5	5	5	4
Egg	1	1	1	0	0	1	0
Dung	23	22	21	21	18	18	17
Others^	3	3	4	4	3	4	4
Value of Livestock Output at Constant Prices (Rs. billion) (2004-05)							
Milk	114	119	128	130	159	165	177
Meat	8	9	9	9	9	10	11
Egg	1	1	1	1	1	1	1
Dung	39	39	40	41	42	43	44
Others^	5	5	5	5	6	6	6
Share of Livestock Output at Constant Prices (%)							
Milk	68	69	70	70	73	73	74
Meat	5	5	5	5	4	4	5
Egg	1	1	1	1	0	0	0
Dung	23	23	22	22	19	19	18
Others^	3	3	3	3	3	3	3

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

Source: NDDB (2016).

Animal husbandry contributed over 11 percent to the Gross State Domestic Product. More than 80 percent rural families keep livestock in their households. About 35 percent of the income of small and marginal farmers came from dairy and animal husbandry. In arid areas, the contribution was as high as 50 percent. The sector has potential to create employment in rural areas with least investments as compared to other sectors. Milk contributed to around 28 percent to the agricultural GDP of Rajasthan and is one of the biggest sectors for supporting livelihood in the state. Livestock output at constant prices was reported at Rs. 239 billion in 2010-11 (at constant prices), of which milk contributes about 74 percent or Rs. 177 billion (Table 2.2).

2.3 Growth Pattern of Major Livestock Population in the State

The state of Rajasthan is rich in livestock wealth. State is blessed with the best breeds of cattle, sheep and camels in the country. The climatic conditions are adverse with scarcity of water for irrigation and erratic rains with very low average annual rainfall. These conditions leave a little scope for crop production and enhance the importance of animal husbandry over the crop production especially during recurrent droughts. The Nineteenth Livestock Census (2012) of India placed total livestock population at 512.1 million, out of which, 57.73 million livestock (11.3 percent) population was in the state of Rajasthan (Table 2.3). There is an increase in livestock population during the period from 56.66 million in 2007 to to 57.73 million in 2012 for animals of various species. In fact, the share of the Rajasthan in all India total stock of livestock has also increased considerably over the period of time (8.4 percent in 1951 to 11.3 in 2012) (Table 2.3). The state accounted for 6.98 percent share in cattle population, 11.94 percent of buffalo population, 13.95 percent sheep population and 16.03 percent goat population of the country (Table 2.4). The state ranked 1st in donkeys, goat and camel production, 2nd in buffalo population and 3rd in sheep population in the country. Significant share of Camels (81.37 percent) and Donkeys (25.56 percent) in national stock is also noteworthy (2012). Main strengths of livestock sector of the State are that it produces 11 percent milk, 35 percent wool and 10 percent meat of the country.

Table 2.3: Growth of the Livestock in Rajasthan and India

Sr. No	Livestock Census Year	Total Livestock (000)		% Share of Rajasthan to All India	% Growth of Rajasthan State between two Censuses
		All India	Rajasthan		
1	1951	292784	24642	8.4	
2	1956	306615	32427	10.6	31.6
3	1961	336432	34499	10.3	6.4
4	1966	344111	37476	10.9	8.6
5	1972	353338	38678	10.9	3.2
6	1977	369525	41359	11.2	6.9
7	1983	419588	49650	11.8	20.0
8	1987	445285	40901	9.2	-17.6
9	1993	470830	48482	10.3	18.5
10	1997	485385	54655	11.3	12.7
11	2003	485002	49136	10.1	-10.1
12	2007	529698	56663	10.7	15.3
13	2012	512057	57732	11.3	1.9

Note: Figures without Dog & Rabbit.

Sources: GOI (2015, 2016) & GOR (2015).

However, share of cattle population in total livestock population declined from 42.26 percent in 1951 to 23.08 percent in 2012, while share of buffalo population increased considerably (11.93 percent to 22.48 percent) during corresponding period. The rate of increase in buffaloes population (326 percent) was much faster as compared to rate of increase in cows population (23.57 percent). In case of small ruminants, sheep population increased by 68.55 percent and goat population increased by 289.56 percent in 2012 over 1951. Total livestock population in Rajasthan increased by 126.25 percent during last six decades period (Table 2.5 and Fig. 2.1).

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

Sr. No.	Particulars	Rajasthan -2012				India 2012	
		Livestock-2012	% share in India	% share in total Livestock	Rank in All India	Livestock-2012	% share in Total Livestock
1	Cattle	13324	6.98	23.08	5	190904	37.28
2	Buffaloes	12976	11.94	22.48	2	108702	21.23
3	Sheep	9080	13.95	15.73	3	65069	12.71
4	Goats	21666	16.03	37.53	1	135173	26.4
5	Pigs	238	2.31	0.41	17	10294	2.01
6	Horses & Ponies	38	6.05	0.07	4	625	0.12
7	Mules	3	1.72	0.01	11	196	0.04
8	Donkeys	81	25.56	0.14	1	319	0.06
9	Camel	326	81.37	0.56	1	400	0.08
10	Yaks	0	0.00	0.00	-	77	0.02
11	Mithun	0	0.00	0.00	-	298	0.06
12	Total Livestock	57732	11.27	100.00	2	512057	100

Note: Figures without Dog & Rabbit

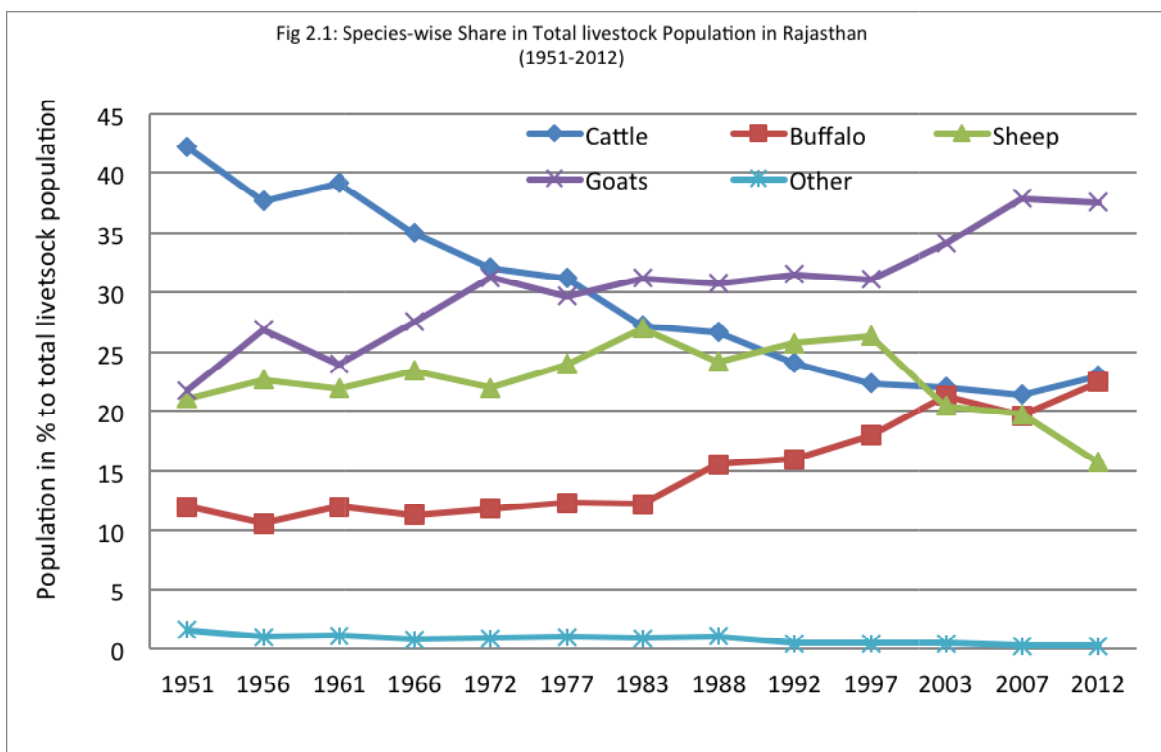
Source: GOR (2015, 2016), Department of Animal Husbandry, Rajasthan.

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

Sr. No.	Year	Cattle		Buffalo		Sheep		Goat		Total Livestock	
		Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)	Nos.	GR (%)
1	1951	107.82	-	30.45	-	53.87	-	55.62	-	255.16	-
2	1956	120.73	11.97	34.30	12.64	73.73	36.87	87.30	56.96	324.28	27.09
3	1961	131.36	8.80	40.19	17.17	73.60	-0.18	80.52	-7.77	335.09	3.33
4	1966	131.23	-0.10	42.23	5.08	88.06	19.65	103.23	28.20	374.76	11.84
5	1972	124.70	-4.98	45.92	8.74	85.56	-2.84	121.62	17.81	388.78	3.74
6	1977	128.96	3.42	50.72	10.45	99.38	16.15	123.07	1.19	413.59	6.38
7	1982	135.04	4.71	60.43	19.14	134.31	35.15	154.8	25.78	496.5	20.05
8	1988	109.21	-19.13	63.44	4.98	99.32	-26.05	125.78	-18.75	409.17	-17.59
9	1992	116.66	6.82	77.75	22.56	124.91	25.77	152.85	21.52	484.45	18.40
10	1997	121.41	4.07	97.70	25.66	145.85	16.76	169.71	11.03	546.55	12.82
11	2003	108.54	-10.60	104.14	6.59	100.54	-31.07	168.09	-0.95	491.36	-10.10
12	2007	121.20	11.66	110.92	6.51	111.9	11.30	215.03	27.93	566.63	15.32
13	2012	133.24	9.93	129.76	16.99	90.8	-18.86	216.66	0.76	577.32	1.89

Note: GR- Growth rate over previous year.
 Source: GOR (2015), Department of Animal Husbandry, Rajasthan.

The district-wise share in total state livestock population figures indicate that (Fig. 2.2 & Table 2.6) Barmer district (9.30 percent) had the highest number of livestock population followed by Jodhpur, Jaisalmer, Nagour, Jaipur, Udaipur, Bikaner, Bhilwara and Pali. These nine districts together accounted for 49.21 percent of total livestock population in the state (Fig. 2.2).



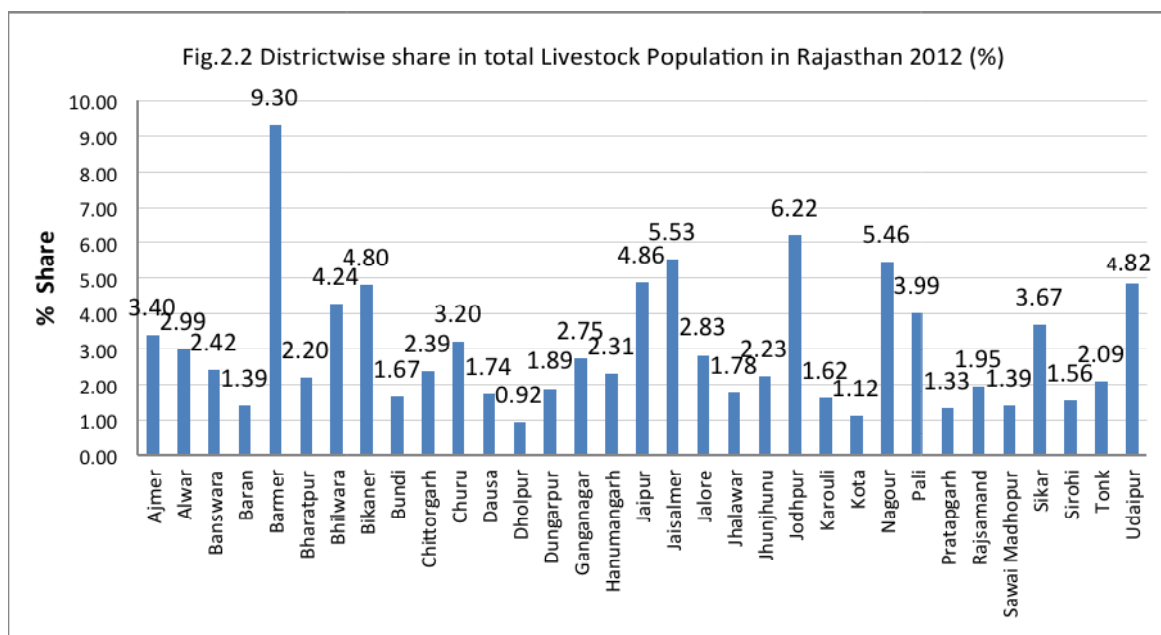


Table 2.6: District wise Percentage share of Animals in Total Livestock Population

District	District wise Percentage share of animals in Total livestock population in Rajasthan-2012											
	Cross-bred	Indige-nous	Total Cow	Buffalo	Sheep	Goat	Total Pigs	Horses & Ponies	Mules	Donkey	Camel	Pig
Ajmer	2.18	18.41	20.59	22.33	18.58	37.18	0.09	0.00	0.11	0.08	1.05	2.18
Alwar	3.22	7.30	10.53	53.97	2.65	19.32	0.05	0.03	0.07	0.30	0.77	3.22
Banswara	0.50	29.94	30.45	14.37	0.37	25.68	0.01	0.00	0.09	0.03	0.01	0.50
Baran	0.27	17.18	17.45	12.73	0.49	9.34	0.03	0.01	0.05	0.04	0.61	0.27
Barmer	0.12	39.99	40.11	10.90	71.44	147.38	0.13	0.00	0.89	2.20	0.01	0.12
Bharatpur	1.90	6.59	8.49	42.55	3.31	8.77	0.04	0.00	0.07	0.12	1.24	1.90
Bhilwara	6.20	30.32	36.53	23.01	20.63	43.08	0.11	0.01	0.06	0.24	0.74	6.20
Bikaner	2.92	43.18	46.10	9.84	33.23	48.94	0.16	0.00	0.44	2.35	0.04	2.92
Bundi	0.71	11.65	12.36	16.12	2.75	16.76	0.07	0.00	0.04	0.14	0.69	0.71
Chittorgarh	1.68	21.56	23.25	20.01	2.24	24.16	0.09	0.00	0.02	0.11	0.21	1.68
Churu	1.63	16.05	17.68	14.89	17.73	41.72	0.04	0.01	0.26	1.73	0.06	1.63
Dausa	1.73	5.30	7.02	24.85	2.84	15.59	0.04	0.00	0.02	0.12	0.55	1.73
Dholpur	0.32	2.71	3.04	18.27	0.60	4.56	0.03	0.01	0.04	0.02	0.36	0.32
Dungarpur	0.14	18.94	19.08	11.81	3.19	21.20	0.01	0.00	0.06	0.09	0.00	0.14
Ganganagar	8.79	23.59	32.38	13.79	13.91	19.56	0.05	0.01	0.23	0.63	0.09	8.79
Hanumangarh	4.98	20.56	25.54	19.81	9.63	10.84	0.06	0.02	0.17	1.59	0.07	4.98
Jaipur	17.55	14.76	32.31	54.61	11.70	42.59	0.06	0.00	0.07	0.25	1.08	17.55
Jaisalmer	0.08	22.03	22.11	0.21	60.30	77.00	0.06	0.00	0.30	2.54	0.06	0.08
Jalore	0.11	14.94	15.05	23.87	19.61	23.89	0.10	0.00	0.17	0.26	0.04	0.11
Jhalawar	0.16	19.18	19.34	15.80	0.58	15.95	0.07	0.00	0.04	0.01	0.36	0.16
Jhunjhunu	9.34	2.50	11.84	19.58	6.41	26.54	0.06	0.01	0.08	0.65	0.17	9.34
Jodhpur	2.87	40.29	43.16	15.53	37.20	85.57	0.08	0.01	0.21	0.85	0.04	2.87
Karouli	0.46	4.68	5.14	24.25	2.88	14.40	0.03	0.01	0.04	0.17	0.58	0.46
Kota	0.46	10.86	11.33	12.03	0.93	7.61	0.02	0.00	0.02	0.09	0.75	0.46
Nagour	3.69	21.83	25.52	28.32	29.76	75.56	0.11	0.00	0.09	0.54	0.38	3.69
Pali	0.46	17.63	18.09	15.86	43.28	39.05	0.06	0.00	0.11	0.42	0.27	0.46
Pratapgarh	0.80	15.99	16.79	7.66	1.12	13.22	0.01	0.00	0.02	0.01	0.12	0.80
Rajsamand	1.33	11.94	13.27	11.31	5.11	27.32	0.05	0.00	0.05	0.08	0.16	1.33
S.Madhopur	0.09	5.50	5.60	16.19	4.23	13.86	0.05	0.00	0.06	0.19	0.71	0.09
Sikar	10.23	6.62	16.84	28.19	7.44	54.61	0.04	0.00	0.06	0.36	0.21	10.23
Sirohi	0.16	9.74	9.90	9.47	10.47	15.66	0.03	0.01	0.07	0.21	0.03	0.16
Tonk	0.48	11.10	11.58	19.92	10.21	19.12	0.05	0.00	0.01	0.04	0.55	0.48
Udaipur	2.70	46.76	49.46	28.17	7.15	56.31	0.04	0.00	0.12	0.14	0.08	2.70
	3.01	20.07	23.08	22.48	15.73	37.53	0.07	0.01	0.14	0.56	0.41	3.01

Source: GOR (2015), Department of Animal Husbandry, Rajasthan.

Jaipur district had the highest number of in-milk crossbreds and buffaloes. Bikaner had the highest number of in-milk indigenous cattle followed by Jodhpur and Barmer district. In milk indigenous cattle like Tharparkar cattle breed is native of Jodhpur and Jaisalmer districts in eastern region of Rajasthan whereas Rathi cattle breed is reared for dairy purposes in the northern districts of Shri Ganganagar, Bikaner and parts of Jaisalmer which are irrigated or partially irrigated arid zones. The highest livestock and bovine animal density was recorded in Bharatpur (Table 2.7).

Table 2.7: District-wise Livestock and Bovine Density (1997-2012)

Districts	Livestock (No. per sq km)				Bovine (No. per sq km)			
	1997	2003	2007	2012	1997	2003	2007	2012
Ajmer	248	190	239	232	94	69	86	100
Alwar	194	199	240	206	115	131	140	151
Banswara	259	310	309	309	178	203	204	195
Baran	117	112	124	115	85	74	83	85
Barmer	145	116	158	189	22	24	28	35
Bharatpur	182	207	183	251	127	159	119	198
Bhilwara	259	203	194	234	108	88	85	112
Bikaner	84	81	85	92	22	25	27	36
Bundi	169	155	172	167	95	88	96	97
Chittaurgarh	221	238	256	176	139	141	158	109
Churu	154	104	137	134	39	30	34	46
Dausa	233	243	283	292	143	147	160	182
Dhaulpur	149	158	174	174	110	120	123	138
Dungarpur	273	303	309	289	153	168	175	161
Ganganagar	130	120	151	144	67	61	79	83
Hanumangarh	129	120	140	138	66	67	76	92
Jaipur	208	221	255	252	108	117	131	153
Jaisalmer	64	46	74	83	8	6	9	11
Jalor	170	154	179	153	57	57	66	72
Jhalawar	149	167	182	165	106	111	117	111
Jhunjhunun	210	200	237	217	80	85	92	104
Jodhpur	172	116	146	157	38	31	40	50
Karauli	144	140	177	169	89	84	94	105
Kota	126	126	139	124	86	81	91	88
Nagaur	183	149	176	178	52	44	50	60
Pali	223	172	187	186	60	46	54	54
Pratapgarh	-	-	-	72	-	-	-	108
Rajsamand	26	233	249	242	114	97	110	104
Sawai Madhopur	16	166	196	179	93	86	82	95
Sikar	32	241	293	274	87	91	100	114
Sirohi	188	189	188	175	67	65	72	74
Tonk	175	141	169	168	81	62	77	86
Udaipur	216	253	233	237	122	134	125	130
Rajasthan	159	144	166	169	64	62	68	77

Source: NDDB (2016).

Rajasthan state has three native cattle breeds viz. Rathi, Tharparker and Nagori, having great deal of endurance (Table 2.8). Rathi cattle breed is reared for dairy purposes in the northern districts of Shri Ganganagar, Bikaner and parts of Jaisalmer which are irrigated or partially irrigated arid zones with alluvial or loamy soil. Tharparkar cattle breed is native of the Jodhpur and Jaisalmer districts in eastern

region of the state which has arid climate, characterized by low rainfall and desert soil. Tharparkar is also known as “White Sindhi”, “Cutchi” or “Thari” cattle breed reared for dual purpose of drought and milk production as it can produce milk under rigorous feeding and unfavorable environmental conditions. Nagori cattle breed has been named after the Nagaur district, which is in central part of the state. Nagori cattle is sturdy and used for ploughing, cultivation, drawing water from wells as well as transportation of field produce to markets. Earlier they were used as trotters in light iron-wheeled carts for quick transportation. There was a good demand of Nagori animals in Bihar but after implementation of Rajasthan Bovine Animal (Prohibition on Slaughter and Regulation of Temporary Migration or Export) Act, the demand has reduced. In addition to native breeds, Gir, Malvi, Kankrej and Haryana cattle are found in large numbers in the State. In case of buffalo, there is no native breed. However, enormous numbers of Murrah, Surti buffaloes are reared in the region. The performances of these breeds are presented in Table 2.9.

Table 2.8: Distribution of Rajasthan’s Cattle Breeds

Breed	Breeding Tract	Utility	Distribution
Rathi	Bikaner, Ganganagar and Jaisalmer districts of Rajasthan	Milch	Mainly distributed in Bikaner, Ganganagar and Hanumangarh districts
Tharparkar	Jodhpur, Barmer, Jaisalmer districts of Rajasthan and Kutch district of Gujarat	Milk and Drought	Distributed in Jaisalmer, Jodhpur and Barmer districts
Nagori	Nagaur, Bikaner and Jodhpur districts of Rajasthan	Drought	Mainly distributed across Nagaur, Jodhpur, Bikaner districts

Source: NDDB (2016).

Table 2.9: Performance of Native Cattle Breeds

Parameters	Cattle		
	Rathi	Tharparkar	Nagori
Breed Population as on 2012	1,218,294	486,339	503,193
Average Adult Body Weight (Kg)	Female : 295	Male : 475 Female : 295	Male : 363 Female : 318
Lactation Yield (Kg)	1,560 (1,062 - 2,810)	1,749 (913 - 2,147)	603 (479 - 905)
Lactation Length (days)	336	285	267 (237 - 300)
Calving Interval (days)	512 (420 - 600)	425 (403-565)	455 (420 - 540)
Age at First Calving (days)	1,392 (1,080 - 1,560)	1,231 (1,101 - 1,575)	1,421 (1,260 - 1,500)
Average Milk Fat (%)	3.7 - 4.0	4.9 (4.7 - 4.9)	5.8

Source: NDDB (2016) Animal Genetic resources of India (Agri-IS), NBAGR, ICAR and estimated Livestock Population Breed Wise, Based on Breed Survey 2013, Department of Animal Husbandry, Dairying and Fisheries, MoA&FW, Govt. of India

2.4 Growth in Milk Production and Productivity

Milk is a major source of nutritious food to millions of people and only acceptable source of animal protein for large vegetarian segment of population in Rajasthan. Modern animal breeding technologies for faster multiplication of genetically superior germplasm have contributed significantly to increase in milk production. Rajasthan ranks second among the milk producing states in India, achieving 224.27 lakh MT in 2017-18, which has increased from the 41.46 lakh MT during 1985-86. A numbers of initiatives were taken by the government which could help in improving the milk productivity over the period. Trend showing the increase in milk production over the past three decades is depicted in Fig 2.3. The graph indicates a consistent increase in the production of milk over the years. The milk production has increased from 7,718 thousand tonnes in 2001-2002 to 18,500 thousand tonnes in 2015-16. It registered a growth of 139.70 percent over base year (Table 2.10). In Rajasthan, per capita milk availability is high as compared to national availability and ICMR recommendation. During the year 2017-18, per capita milk availability was very high at 834 gm/day against national availability of 375 gm/day and milk requirement per head per day as per ICMR norms of 208 grams.

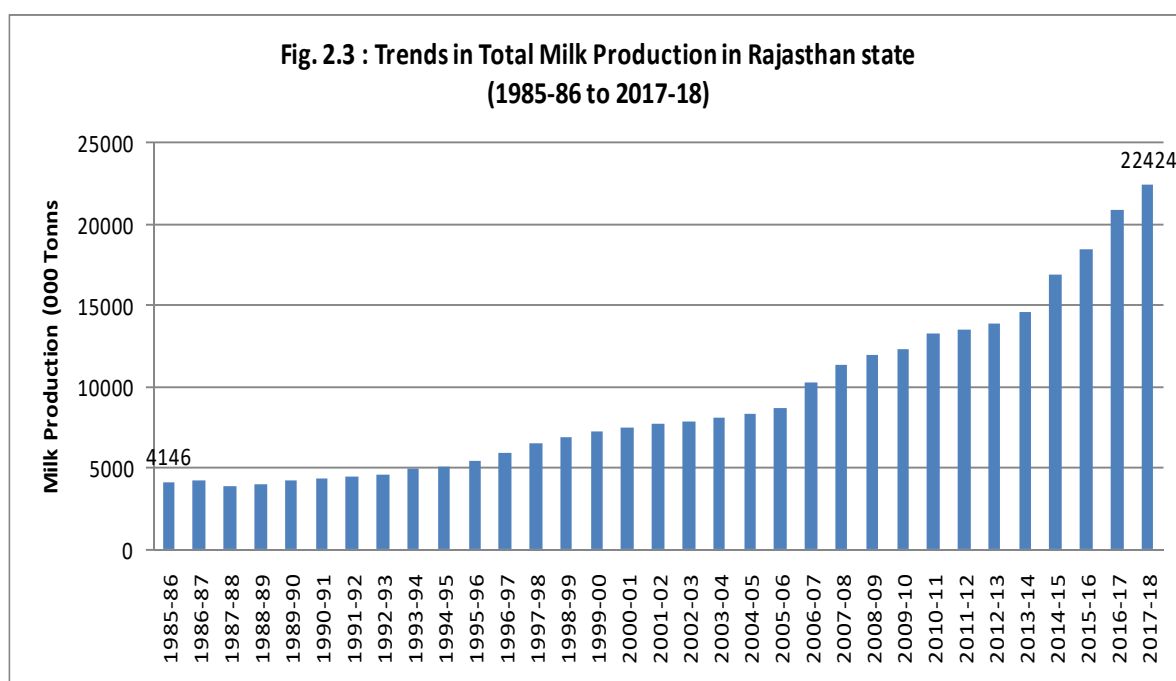
Table 2.10: Milk Production in Rajasthan: 2000-01 to 2017-18

Sr. No	Year	Milk Production in Thousand MT						Growth of Milk Production (%) over base year	Per Capita availability (gms/day)
		In milk Cow		In Milk Buffalo	In milk Bovine	In Milk Goat	Total		
		Indi-genous	C.B.						
1	2001-02	2325	91	4488	6904	814	7718	-	376
2	2002-03	2159	121	4702	6982	866	7848	1.68	368
3	2003-04	2134	157	4899	7190	864	8054	2.62	371
4	2004-05	2148	188	5065	7401	909	8310	3.18	376
5	2005-06	2287	257	5108	7652	981	8633	3.89	387
6	2006-07	2782	606	5571	8959	1350	10309	19.41	449
7	2007-08	3161	681	6012	9854	1523	11377	10.36	486
8	2008-09	3625	703	6033	10361	1572	11933	4.89	501
9	2009-10	3927	882	6074	10883	1448	12331	3.34	509
10	2010-11	4120	913	6611	11644	1590	13234	7.32	538
11	2011-12	3822	867	7153	11842	1669	13511	2.09	539
12	2012-13	4084	913	7238	12235	1712	13947	3.23	555
13	2013-14	4173	938	7682	12793	1781	14574	4.50	572
14	2014-15	4286	1840	8985	15111	1823	16934	16.19	655
15	2015-16	4394	2235	9938	16567	1933	18500	9.24	704

Source: NDDB (2016).

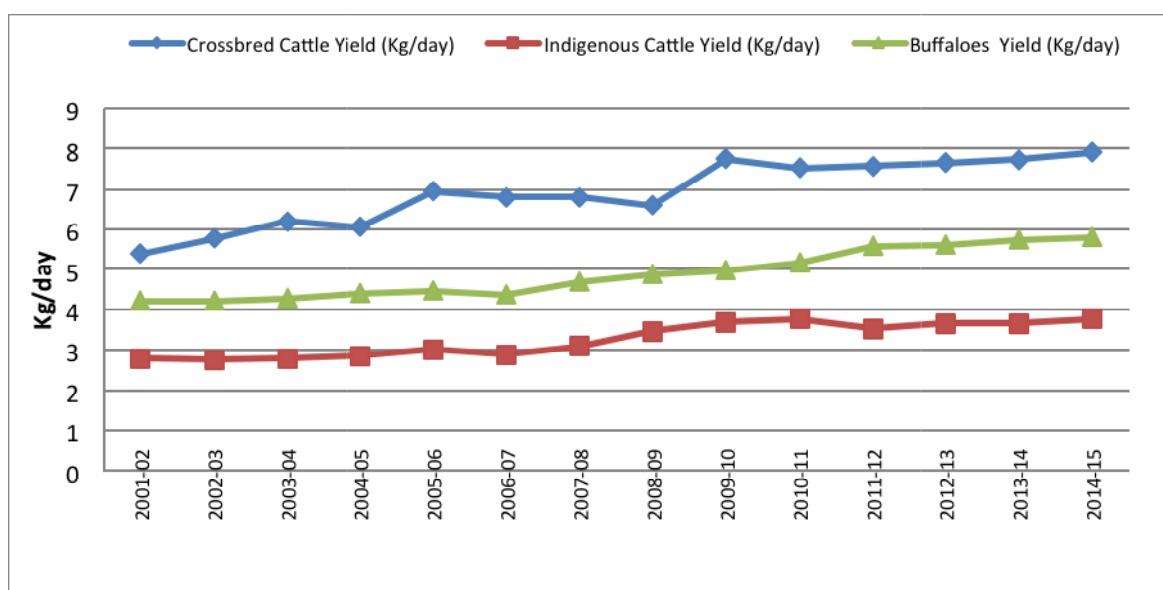
Out of total milk production, about 53.72 percent of the milk production was contributed by Indigenous Buffaloes followed by 23.75 percent by indigenous cattle. The crossbreed cattle contribute 12.08 percent of the total milk production in the state whereas Goat contributed 10.45 percent to total milk production. However, the productivity of cross breed cows was maximum at 7.93 liters per day among all dairy animals. The indigenous cattle was also contributing significantly in milk production, especially in arid and semiarid areas of the state, though its productivity (5.84 ltr/day) is much lower than the cross breed cows and buffaloes. While the productivity of cows and buffaloes in terms of daily milk yield is increasing continuously (Fig 2.4), there is still a wide scope for improving milk yield of milch animals.

Fig. 2.3: Trends in Total Milk production in Rajasthan state - (1985-86 to 2017-18)



Out of total bovine milk production, 59.99 percent is contributed by buffalo milk, 26.52 percent share accounted for indigenous cows and remaining 13.49 percent was contributed by cross breed cows. Significant growth in population of in-milk bovine animals was supported by increase in milk yield of bovine animals which increased (bovine milk production) by 41.67 percent in 2015-16 over 2001-02. The share of cross breed cows in total milk production increased while share of indigenous cows and buffaloes, declined during last one and half decade. Their corresponding share was 65.0 percent, 33.68 percent and 1.32 percent respectively in 2000-01.

Fig 2.4: Species wise Trends in Total Milk Productivity in Rajasthan



Species wise performance of growth in milk production and milk yield during the period from 2001-02 to 2014-15 is presented in Table 2.11. The rate of growth in milk production in the state varied widely for different species. Cross breed cows recorded highest growth rate of 24.32 percent per annum followed by goats 7.30 percent, desi cow 6.03 percent and buffaloes 4.88 percent in the state. Though growth in milk production increased in the state but it was very less at national level as compared to state level. During the same year, crossbreed cow also had highest annual growth in yield of milk (2.88 percent) followed by buffaloes (2.72 percent), indigenous cow (2.69 percent) and goats (1.09 percent) per annum in the state. Nagori, Rathi, Tharparkar and Kankrej are some of the cow breeds found in Rajasthan. Among all cow breeds in Rajasthan, Tharparkar had the highest yield of 1800 to 2600 kilograms of milk per lactation.

Table 2.11: Growth in Milk production and Milk Yield (2001-02 to 2014-15)

Category	Milk production (%)		Milk yield (%)	
	Rajasthan	India	Rajasthan	India
Cross breed cow	24.32	7.58	2.88	0.74
Desi Cow	6.03	3.39	2.69	2.21
Buffaloes	4.88	3.80	2.72	1.40
Goats	7.30	3.27	1.09	0.23

Source: GOR (2015, 2016), Annual Report, Directorate of Animal Husbandry, Jaipur.

Alwar was the highest milk producing district in the state with an estimated milk production of about 1116 thousand tonnes during 2013-14 (Table 2.12). Jaipur was the second largest producer of milk (7.44 percent) followed by Jodhpur (5.39 percent) and Ajmer (4.66 percent). The top ten districts that together contributed half of the state milk production include Alwar, Jaipur, Jodhpur, Ajmer, Pali, Barmer, Sikar, Ganganagar, Nagour and Jhunjhunu. The five top ranked milk producer districts in Rajasthan were dominated by the production of milk by buffalo, followed by indigenous cow, cross breed cows and goats.

Table 2.12: Districtwise & Categorywise Percentage share of Milk Production in Rajasthan

Name of the District	District wise & category wise %age share of Milk Production in Rajasthan (2013-14)					
	% share of Crossbred Cow	% share of Indigenous Cow	% share of Total Cattle	% share of Buffalo	Goat	% share to total Milk Production
Ajmer	0.81	5.08	5.90	8.17	2.18	4.66
Alwar	0.36	2.59	2.95	21.36	2.42	7.66
Banswara	0.12	1.97	2.09	4.22	0.79	2.03
Baran	0.05	2.21	2.25	3.16	0.48	1.68
Barmer	0.00	8.27	8.27	2.59	3.40	4.09
Bharatpur	0.43	1.37	1.80	6.09	0.41	2.37
Bhilwara	1.63	4.22	5.85	4.53	1.29	3.34
Bikaner	1.17	6.47	7.65	2.42	1.61	3.34
Bundi	0.12	3.12	3.24	5.49	0.55	2.66
Chittaurgarh	0.89	3.12	4.00	5.94	0.96	3.12
Churu	0.36	2.66	3.02	3.64	1.92	2.46
Dausa	0.43	1.08	1.51	7.69	0.98	2.92
Dhaulpur	0.02	0.84	0.86	3.36	0.29	1.29
Dungarpur	0.02	1.94	1.97	3.21	0.74	1.70
Ganganagar	3.07	5.80	8.87	3.57	0.72	3.77
Hanumangarh	1.15	3.60	4.75	4.82	0.65	2.92
Jaipur	3.45	3.81	7.26	16.90	1.80	7.44
Jaisalmer	0.02	3.50	3.52	0.05	2.56	1.75
Jalor	0.02	2.66	2.68	5.25	0.96	2.55
Jhalawar	0.02	1.99	2.01	4.65	0.84	2.15
Jhunjhunun	2.71	1.58	4.29	7.17	1.68	3.76
Jodhpur	1.20	7.33	8.53	7.50	2.78	5.39
Karauli	0.07	0.86	0.93	4.72	0.89	1.87
Kota	0.10	1.51	1.61	3.33	0.48	1.55
Nagaur	0.38	4.10	4.48	6.23	2.92	3.91
Pali	0.14	6.52	6.66	6.38	1.68	4.22
Rajsamand	0.60	1.27	1.87	3.67	0.74	1.81
Sawai Madhopur	0.05	1.37	1.41	5.61	0.65	2.20
Sikar	2.49	2.97	5.47	9.61	2.09	4.91
Sirohi	0.02	1.51	1.53	2.47	0.91	1.41
Tonk	0.12	2.04	2.16	4.22	0.89	2.09
Udaipur	0.48	2.42	2.90	5.99	1.41	2.95

Source: GOR (2016a).

At present both private and co-operative organizations are engaged in the production, procurement, processing and marketing of milk in the state. The milk producers who sell their milk through private local traders are always exploited. The private traders who have been interested in maximizing their own profits are least

concerned about improving the productivity of dairy farming. The onus, therefore, lies on the cooperative sector and primary milk cooperative societies to help dairy farmers in developing dairy as an industry.

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

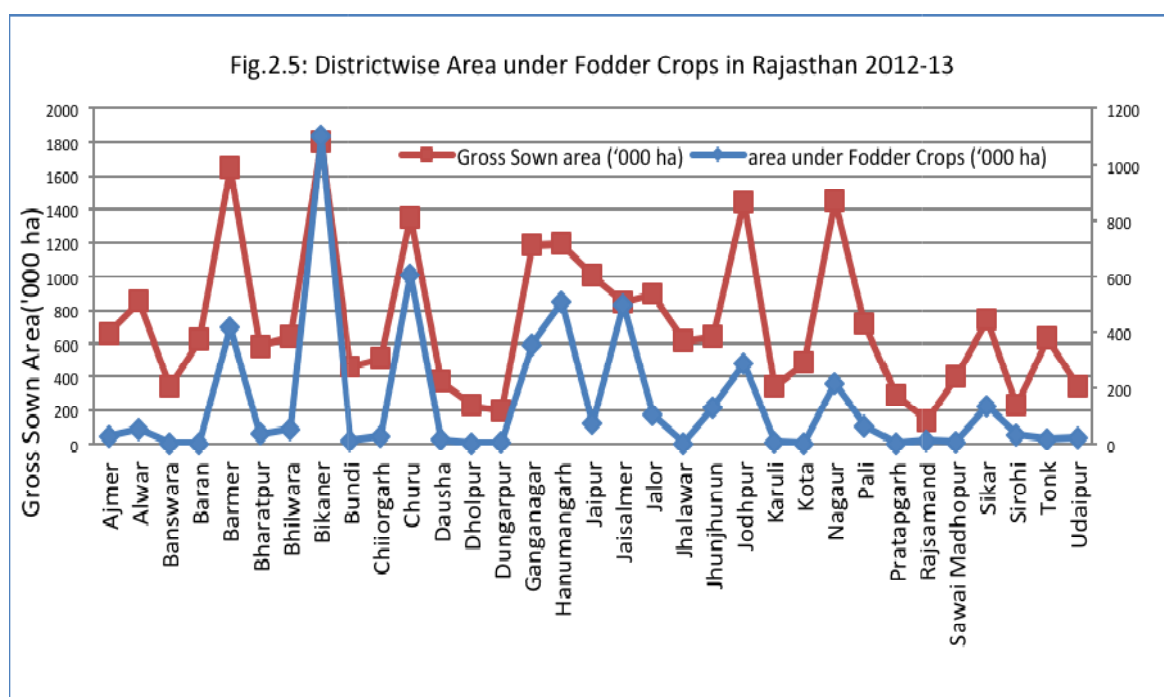
Feed and fodder availability in drought prone area of the state is a major constraint of dairy development in Rajasthan. Dairying is the most reliable source of earning for farmers in Rajasthan. But with disappearing grazing land, restricted forest and stall feeding, the bovine animal farmers are facing a severe shortage of fodder. High population pressure on grazing lands has led to depletion and over exploitation of available grazing lands. In addition, rapid urbanization has led to shrinking of grazing lands. Moreover, with the increasing pressure on land for growing food grains, oil seeds and pulses and diversified use of agriculture residues, the gap between the demand and supply of fodder is increasing. It is estimated that a perpetual shortage of fodder in the state of Rajasthan is to the tune of 40 percent..

In Rajasthan, the livestock keepers have traditionally relied on common grazing lands “gochars”, sacred groves “orans” and forests. With the growth of mining industry and allocation of community wastelands for biodiesel plantation, the permanent pastures and other grazing land has reduced from 1.9 million ha in 1990-91 to 1.7 million ha in 2009-10. Often layers of white marble dust choke neighbouring grazing land. Rajasthan is a leader in crops like sorghum, pearl millet (bajra), pulses, oil seeds, wheat and rice, all of which in some way or other, form parts of compound livestock feed. Rajasthan also produces non-conventional ingredients, which can be integral part of the feed raw material. Now the dairy farmers are shifting from extensive open grazing system to semi-intensive and intensive stall feeding system. Green fodder is a comparatively economical source of nutrients. However, the availability of green fodder is lower than estimated requirement. In Rajasthan, the area under fodder crop to state gross cropped area increased from 15.93 percent in 2008-09 to 20.26 percent in 2012-13 (Table 2.13 and Figure. 2.5). Bikaner District had the highest area under fodder crops followed by Churu, Hanumangarh and Jaisalmer District.

Table 2.13: Area under Fodder Crops in Rajasthan

Districts	Area under Fodder Crops ('000 ha)					Gross Sown area ('000 ha)				
	2008-09	2009-10	2010-11	2011-12	2012-13	2008-09	2009-10	2010-11	2011-12	2012-13
Ajmer	17	15	13	12	27	493	436	775	640	664
Alwar	50	35	34	30	55	809	864	859	854	853
Banswara	2	2	2	2	2	316	325	332	337	340
Baran	2	3	2	2	2	550	547	574	593	629
Barmer	360	370	411	430	417	1,777	1,820	1,979	1,868	1,646
Bharatpur	30	31	27	26	35	562	603	597	591	587
Bhilwara	47	35	36	30	54	520	456	733	624	643
Bikaner	891	653	884	908	1,101	1,784	1,502	1,880	1,884	1,807
Bundi	15	15	18	13	14	413	384	444	461	464
Chiiorgarh	21	21	22	21	27	492	423	520	505	518
Churu	350	295	248	327	608	1,459	1,283	1,575	1,528	1,355
Dausa	18	14	12	11	15	351	382	392	384	378
Dholpur	3	3	3	3	4	208	229	226	230	230
Dungarpur	4	5	5	5	5	158	186	187	200	200
Ganganagar	282	187	217	216	357	1,092	947	1,073	1,107	1,187
Hanumangarh	389	215	310	314	509	1,237	1,014	1,278	1,220	1,198
Jaipur	73	70	59	53	71	963	934	1,172	1,091	1,013
Jaisalmer	374	318	426	430	500	728	626	878	848	844
Jalor	66	63	61	50	103	813	824	1,126	911	895
Jhalawar	3	4	3	3	4	549	579	570	601	614
Jhunjhunun	79	67	61	66	132	655	614	734	668	644
Jodhpur	174	148	153	158	291	1,420	1,402	1,580	1,516	1,449
Karauli	5	5	4	3	7	306	348	344	340	340
Kota	5	5	5	4	4	435	439	459	462	492
Nagaur	135	92	78	91	217	1,460	1,411	1,859	1,469	1,453
Pali	66	53	46	35	65	645	631	887	702	721
Pratapgarh	2	2	2	2	2	272	267	272	283	291
Rajsamand	12	9	10	8	12	110	99	146	139	140
S.Madhopur	7	6	5	4	8	372	425	412	398	400
Sikar	87	76	72	80	134	743	715	847	777	748
Sirohi	23	22	22	18	32	192	171	241	233	230
Tonk	16	14	13	13	19	584	575	715	691	637
Udaipur	22	22	22	21	22	303	284	336	348	342
Rajasthan	3,627	2,875	3,287	3,386	4,853	22,771	21,745	26,002	24,505	23,954

Source: NDDB (2016).



As against the estimated animals' requirements, feed resources available in Rajasthan are lower. It is estimated that against the requirement of 375 lakh MT of dry fodder, state availability was of 368 lakh MT of dry fodder. It can be seen that during the last two decade (1992 to 2011), as given in Table 2.14, shortage of dry matter in the State increased from 29.01 percent of the requirement to 51.88 percent during corresponding years. Six cattle feed plant, in the cooperative sector and spread across the State, produced about 1650 MTPD during 2016. The state runs a programme of distribution of fodder seed mini kit with the assistance of Central Government through the department to promote the green fodder production (Table 2.15). To improve the nutritive value and digestibility of the straw, urea molasses treatment is being done. In addition, demonstrations had been conducted to promote the programme. Regional Station for Forage Production and Demonstration was established by State Government at Dudli-Bassi (Jaipur) that has active liaison between regional Agricultural Universities, National Agriculture Research Institutes, and the farmers for quickly transferring the findings of research.

Table 2.14: Dry Matter Availability, Requirement & Surplus/Deficit in Rajasthan

Year	Dry Matter Availability, Requirement and Surplus/Deficit in Rajasthan (000 MT)		
	Availability	Requirement	Deficit/ Surplus
1992	33,571	55,046	-21,475
1997	35,848	66,634	-30,786
2003	29,523	66,153	-36,630
2007	45,655	74,298	-28,643
2008	47,310	76,464	-29,154
2009	47,052	78,929	-31,877
2010	38,218	81,703	-43,485
2011	40,809	84,808	-43,999

Source: ICAR-NIANP (2012)- Feedbase 2012, National Institute of Animal Nutrition and Physiology, Bangalore.

Table 2.15: Achievement of Feed and Fodder Development Program during 2010-11 to 2014-15

Sl	Particulars	Unit	2010-11	2011-12	2012-13	2013-14	2014-15
1	(a) Sell of fodder seed	Qtl.					
	(b) Free Distribution of Fodder seed	Qtl.	5397.98	1434.93	47.28	111.39	*
2	Fodder seed Production	Qtl.	53.8	11.85	17.5	13	*
3	Minikit Feed for Demonstration						
	(0.1 Hectare / Demonstration)	Nos	48084	33824	585	2100	*
4	Fodder Production in State farm						
	(a) Green Fodder	Qtl.	517.2		7673.25		*
	(b) Dry fodder	Qtl.		4940.5	585	6904.74	*
5	Fodder received by Cattle breeder for Demonstration	Qtl.	119242.1	175235.4	8258.25	10916	*
6	Meeting for Fodder Development	Qtl.	2496	1214	258	980	*
7	Demonstration of treated fodder by Ureamolasy	Nos					*
8	Tree Plantation	Qtl.	49781	26178	10989	7585	*

Note: *No subsidy was given by the Indian government for feed, seeds and others
Source: GOR (2015), Annual report 2014-15, Department of AH&D.

Cattle Feed

Balanced cattle feed is being manufactured by five cattle feed plants viz. Ajmer, Nadbai, Bikaner, Jodhpur and Lambiyakalan (Table 2.16). The milk unions make feed available to the farmers via village level dairy cooperative societies. The available range of Cattle Feed are balanced cattle feed, high energy feed & bypass Protein Cattle feed supplements like Urea Molasses Bricks (UMB) and Mineral mixture.

Table 2.16: Functional Cattle Feed Plants with their Production Capacity/ day MT

Plant	Ajmer	Nadbai	Bikaner	Jodhpur	Lambiyakalan
Production Capacity	300	300	300	300	150

Source: <http://sarasmilkfed.rajasthan.gov.in/tech.aspx>

Under the recent major input programme, fodder development activities have been taken up by RCDF through which the major fodder crops and their seed are grown on Rojhri, Bassi and Pal Farms and seed is supplied to the dairy farmers on no-profit-no-loss basis. The major fodder crops are Lucerne, Oats, Bajra, Berseem, Sorghum, Sudan-Grass, etc. The federation also procures quality seeds from other agencies & provides them to the farmers.

Gaushala Development Programme:

Under the Rajasthan Goshala Act 1960, till now 1163 Goshalas have been registered. These Goshalas have been established by the public trusts for maintaining old, infirm, unproductive cows and its progeny. Goshalas may be used for preservation & conservation of indigenous breeds. The central government as well as state government is also assisting these Goshalas for cattle development.

2.6 Chapter Summary

The state of Rajasthan is rich in livestock wealth. State is blessed with the best breeds of cattle, sheep and camels of the country. The climatic conditions are adverse with scarcity of water for irrigation and erratic rains with very low average annual rainfall. These conditions leave a little scope for crop production and enhance the importance of animal husbandry over the crop production especially during recurrent droughts. The state ranks 1st in donkeys, goat and camel population, ranks 2nd in buffalo population and rank 3rd in sheep population in the country. The significant

share of Camels (81.37 percent) and Donkeys (25.56 percent) in national stock is noteworthy (2012). Main strengths of livestock sector in the State is that it produces 11 percent milk, 35 percent wool and 10 percent meat of the country. Rajasthan has some of the nationally recognized breeds of milch and drought cattle viz. Ralhi, Tharparkar, Gir, Kankrej, Sahiwal and Nagauri. Malvi and Haryanvi have their home tracts in Rajasthan. This indicates that the cattle in the state are of better quality in comparison to those found in other parts of the country. However, the number of high yielding indigenous pure breed cattle is reducing and number of non-descript cattle is increasing. The productivity of non-descript cattle is very low and needs to be improved. The status of dairy development in the study area was observed to be low as compared to its expected potential, despite the fact that this region has relatively superior resource endowment. The co-operative dairy structure is very sound in the state except Bharatpur region. The milk cooperative sector in Rajasthan has grown impressively and today includes 14,620 milk cooperative societies attached to 21 district level milk unions (2015-16). The dairy cooperative structure in some area has been weak in comparison to elsewhere in the country. The coverage of dairy cooperatives in terms of villages, milk producers and share of milk procurement in surplus milk is low. There are areas of concern that constrain realization of full potential of this sector. Besides cooperative network, PAAYAS milk Producer Company limited was incorporated on 19th May 2012 under Part IX A of the Companies Act 1956. Feed and fodder availability in drought prone area of the State was a major constraint for dairy development in Rajasthan. As against the estimated animals' requirements, feed resources available in Rajasthan were lower. It is estimated that against the requirement of 375 lakh MT of dry fodder, availability of 368 lakh MT of dry fodder was observed. During the last two decades (1992 to 2011), shortage of dry matter in the State has increased from 29.01 percent of the requirement to 51.88 percent during corresponding years.

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

Socio-Economic Characteristics of Sample Households

3.1 About Study Area:

Rajasthan lies to the north west of India, just above the Tropic of Cancer and is located between 23°30' and 30° 11' North latitude and 69° 29' and 78° 17' East longitude. Rajasthan, with a geographical area of 3,42,239 sq. kms, is India's largest state with a population of 56 million and a density of 165 persons per sq. kms. The state is characterized by diverse terrain ranging from desert and semi-arid regions of western Rajasthan to the greener belts east of the Aravalis and the hilly tribal tracts in the south-east. More than 60 percent of the state's area is desert with sparsely distributed population. Agriculture is dependent on rainfall and failure of monsoon causes severe drought and scarcity conditions. It is deficient in water (the state has only 1 percent of total surface water). Ground water at many places is unfit for human and livestock consumption. State is categorized into 10 agro-climatic zones (see Map 3.1), which can broadly be divided into arid, semi-arid and sub-humid regions, on the basis of rainfall intensities. The selected three districts (Ajmer, Barmer and Udaipur) represents the three different ACZs of the state viz. IIA& IIB; IA; and IVA.

Map 3.1: Agro-Climatic Zones of Rajasthan



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 47 years of which almost one third 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 62 per cent were from backward classes, followed by around 18 per cent from open category, 15 per cent from Scheduled tribe and rest of them were from Schedules Tribe. Most of the selected households respondents were male (93 per cent) and very few (7 per cent) were female respondents.

The selected households had slightly higher experience in farming business (23 years) followed by dairy (22 years) and sheep and goat rearing (11 years). The average family size was found to be 6.7 persons and the highest share of family members were found to be primarily engaged in farming business (39 per cent) followed by 36 per cent in dairy 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 82 per cent households followed by animal husbandry and dairy (13 per cent) and very meagre share of household 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. 135559/- followed by Rs. 48640/- from dairy, Rs 10102/- from sheep and goat rearing. Around 71 per cent of the selected households were found be a no association with any 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)	47.10	
2	Education level (%)		
	Illiterate	31.18	
	Primary (1 to 4)	25.81	
	Middle School (5 to 8)	18.28	
	High School (9-12)	18.28	
	Graduate	0.54	
	Post Graduate & above	5.91	
3	Caste (%)		
	General	18.28	
	OBC	61.83	
	SC	4.84	
	ST	15.05	
4	Gender (%)		
	Male	93.01	
	Female	6.99	
5	Average Experience (Years)		
	Farming	22.71	
	Dairying	21.72	
	Sheep & Goat rearing	10.50	
6	Average family Size (No.)	6.71	
7	Average Income (Rs)		
	a) Agriculture	135559	
	b) Dairy	48640	
	c) Sheep & Goat farming	10102	
	d) Other	10589	
8	Average No. of family members engaged		
	Farming	39.0	
	Dairying	35.6	
	Sheep & Goat rearing	14.7	
9	Occupation	Primary	Secondary
	Agriculture	82.26	10.75
	Animal Husbandry & dairy	12.90	87.10
	Agri Labour	0.54	1.61
	Non- Farm labour	0.00	0.00
	Trade	0.00	0.00
	Employee	2.69	0.00
	Other (Specify)	1.61	0.54
10	Member of Social & Cooperative Organization (%)	Yes	No
		29.03	70.97

Source: Field Survey data.

3.3 Chapter Summary

The chapter presented the profile of the selected households. The varying topographic features of Rajasthan justify the selection of three districts (Ajmer, Barmer and Udaipur) from three regions, i.e. Central, West and South region of Rajasthan as well as three different ACZs of the state viz. IIA& IIB; IA; and IVA.. The average age of the selected household head/respondent was around 47 years of which almost one third 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 62 per cent were from backward classes, followed by around 18 per cent from open category, 15 per cent from Scheduled tribe and rest of them were from Schedules Tribe. Most of the selected households respondents were male (93 per cent) and very few (7 per cent) were female respondents. The selected households had slightly higher experience in farming business (23 years) followed by dairy (22 years) and sheep and goat rearing (11 years). The average family size was found to be 6.7 persons and the highest share of family members were found to be primarily engaged in farming business (39 per cent) followed by 36 per cent in dairy 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 82 per cent households followed by animal husbandry and dairy (13 per cent) and very meagre share of household 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. 135559/- followed by Rs. 48640/- from dairy, Rs 10102/- from sheep and goat rearing. Around 71 per cent of the selected households were found be a no association with any 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 small to medium size of holdings having 2.12 ha of which 82 per cent land was irrigated. It was very surprising and pleasant to note that almost 19 per cent of total operational holdings was devoted to fodder crops, while same was slightly higher in case of land under irrigated condition (19 per cent) as compared to 18 per cent land was under fodder by rainfed land holders. The groundwater the main source of irrigation (more than 7 per cent) 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)	1.66	0.37	2.03
2	Leased in Land (ha)	0.09	0.00	0.09
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)	1.75	0.37	2.12
6	Area under Fodder crop (ha)	0.32	0.07	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		1.3	
	Bore well		30.7	
	Dug well		39.3	
	Tank		0	
	Other		5.3	
	Multiple sources (canal & well)		22.7	
	Multiple sources (tank and other)		0.7	

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 lucerne were grown. Table 4.2b indicates that fodder cultivation is found to be relatively 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					
Bajra	127.9	3934.2	3516.2	2965987	5848045
Jowar	46.2	1139.5	1133.0	900505	2170820
Maize	44.7	628.0	507.5	750705	1420000
Urad	3.7	35.0	12.0	102500	145500
Moong	12.3	101.6	21.3	364300	506840
Moth	20.2	174.7	37.4	429200	647500
Sesamum	2.1	12.5	7.1	88900	125000
Soybean	20.0	281.0	193.5	806000	1276400
Castorseed	1.3	28.2	28.2	66000	93000
Cotton	0.8	9.0	9.0	33670	44898
Lucerne	0.2	16.0	20.0	5500	6900
Fodder	34.6	0.0	2651.0	424500	1788000
Cluster bean	25.2	341.6	74.1	498000	1213500
Vegetable	3.0	11.0	11.0	46000	73000
Total	342.1	6712.2	8221.3	7481767	15359403
Rabi					
Wheat	93.4	2707.0	1901.0	2579134	5480800
Jowar	2.2	54.0	44.0	21000	108000
Barley	14.3	737.0	666.0	370000	767500
Gram	9.0	85.2	53.5	116104	389500
Mustard	4.4	71.0	38.0	166400	262500
Castor	13.8	860.0	0.0	258000	3010000
Fodder	11.0	0.0	752.0	165100	677800
Cumin	30.6	423.0	38.0	727000	6253000
Lucerne	13.2	1879.0	1879.0	364400	549000
Vegetable	0.6	95.0	95.0	11000	24000
Total	192.4	6911.2	5466.5	4778138	17522100
Summer					
Bajra	12.6	0.0	527.0	124200	674100
Rajka Bajra fodder	2.6		195.0	25500	132500
Jowar Fodder	0.8		122.0	10400	39000
Maize fodder	0.2		15.0	4500	10000
Lucerne	1.3		74.0	11500	55000
Fodder	2.7		213.0	21500	106500
Vegetables	0.5	60.0	0.0	37000	78000
Total	20.7	60.0	1146.0	234600	1095100
Grand Total	555.2	13683.4	14833.8	12494505	33976603

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				
Bajra	23195	45734	22539	30.8
Jowar	19487	46977	27490	24.7
Maize	16807	31792	14985	14.1
Urad	28082	39863	11781	9.6
Moong	29582	41156	11575	8.2
Moth	21206	31991	10786	8.6
Sesamum	41639	58548	16909	5.9
Soybean	40300	63820	23520	14.1
Castorseed	51563	72656	21094	22.0
Cotton	44893	59864	14971	12.0
Lucerne	26829	33659	6829	78.0
Fodder	12278	51714	39436	0.0
Cluster bean	19778	48193	28415	13.6
Vegetable	15333	24333	9000	3.7
Total	21872	44901	23029	19.6
Rabi				
Wheat	27623	58700	31077	29.0
Jowar	9600	49371	39771	24.7
Barley	25965	53860	27895	51.7
Gram	12900	43278	30377	9.5
Mustard	37647	59389	21742	16.1
Castor	18750	218750	200000	62.5
Fodder	14975	61478	46503	0.0
Cumin	23789	204614	180825	13.8
Lucerne	27523	41465	13943	141.9
Vegetable	17600	38400	20800	152.0
Total	24830	91053	66224	35.9
Summer				
Bajra	9889	53670	43782	42.0
Rajka Bajra fodder	9714	50476	40762	74.3
Jowar Fodder	13867	52000	38133	162.7
Maize fodder	22500	50000	27500	75.0
Lucerne	8712	41667	32955	56.1
Fodder	7847	38869	31022	77.7
Vegetables	74000	156000	82000	120.0
Total	11336	52916	41580	55.4
Grand Total	23195	45734	22539	30.8

Source: Field survey data.

4.4 Details of Value of Animals

As per Livestock Census 2012, Barmer district (9.3 %) has the highest number of livestock population followed by Jodhpur, Jaisalmer, Nagour, Jaipur, Udaipur,

Bikaner, Bhilwara and Pali. These nine districts together accounted for 49.21 percent of total livestock population in the state. The details on district wise classification of animals of the sample households are presented in Table 4.3. The selected three districts (Ajmer, Barmer and Udaipur) represents the of the state viz. Central, West and South region of Rajasthan.

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	Ajmer	29	19	25	73	33
2	Barmer	66	75	63	204	91
3	Udaipur	41	57	34	132	62
	Grand Total	136	151	122	409	186

Source: Field survey data.

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

Sr. No.		Banaskantha	Panchamahar	Surat	Grand Total	% to Total
1	Buffalo					
	>1 year	2	0	1	3	0.89
	1-2 Year	3	7	5	15	4.46
	< 2 Years	81	157	80	318	94.64
	Total	86	164	86	336	100.00
2	Crossbred Cattle					
	>1 year	0	1	1	2	1.16
	1-2 Year	0	0	0	0	0.00
	< 2 Years	15	2	153	170	98.84
	Total	15	3	154	172	100.00
3	Indigenous cattle					
	>1 year	0	11	2	13	6.28
	1-2 Year	4	8	1	13	6.28
	< 2 Years	30	132	19	181	87.44
	Total	34	151	22	207	100.00
4	Sheep					
	>1 year	0	30	0	30	15.46
	1-2 Year	0	40	0	40	20.62
	< 2 Years	0	117	7	124	63.92
	Total	0	187	7	194	100.00
5	Goat					
	>1 year	41	82	22	145	12.46
	1-2 Year	49	125	101	275	23.63
	< 2 Years	143	394	207	744	63.92
	Total	233	601	330	1164	100.00

Source: Field survey data.

It can be seen from the Table 4.4 that the more than 94 per cent selected buffalo and Cattle had average age of more than 2 years while around three fifth of

sheet and goats were of same age. The average value of sheet for the age of 2 years and above ranges between as high as around Rs. 8167 in Udaipur and as lowest as Rs. 7100/- in Barmer district while same was for goat of Rs. Rs.6993/- in Barmer and Rs. 5769 in Ajmer district, respectively (Table 4.5).

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

Sr. No.	Age Group	Ajmer	Barmer	Udaipur	Av.
1	Sheep				
	>1 year		3000		3000
	1-2 Year		6875		6875
	< 2 Years		7100	8167	7500
	Grand Total		6000	8167	6433
2	Goat				
	>1 year	2417	4775	3263	4003
	1-2 Year	4346	4567	4875	4656
	< 2 Years	5769	6993	6031	6489
	Grand Total	4618	5804	5063	5361

It can be seen from the Table 4.6 that the average value of the buffalo, crossbreed cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 50000/- , followed by Rs. 44000/- for crossbreed cattle and Rs. 32000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Ajmer district. The average value of animals as per stage of life i.e. heifer not pregnant, heifer pregnant, dry and milching animals are presented in Table 4.7.

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

Sr. No.	Age Group	Ajmer	Barmer	Udaipur	Av.
1	Buffalo				
	>1 year	8500	#DIV/0!	5000	7333
	1-2 Year	18333	23286	24000	22533
	< 2 Years	56358	50380	53713	52741
	Total	53919	49224	51419	50987
2	Crossbred Cattle				
	>1 year	-	10000	35000	22500
	1-2 Year	-	-	-	-
	< 2 Years	49067	25000	43788	44032
	Total	49067	20000	43731	43782
3	Indigenous cattle				
	>1 year	7625	5000	5000	5808
	1-2 Year	-	8591	12500	9192
	< 2 Years	30467	36527	31211	34964
	Total	27779	32821	28318	31514

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

Sr. No.	Age Group	Ajmer	Barmer	Udaipur	Av.
1	Buffalo				
	Milching	56096	53158	57554	55053
	Dry	58571	49250	46533	49740
	Heifer Pregnant	60000	32386	41000	38050
	Heifer non-pregnant	-	30500	43333	34000
2	Crossbred Cattle	8500	-	5000	7333
	Milching	18333	23286	24000	22533
	Dry	53919	49224	51419	50987
	Heifer Pregnant	-	-	-	-
	Heifer non-pregnant	49667	25000	44797	44942
3	Indigenous cattle	46667	-	42258	42647
	Milching	-	-	34600	34600
	Dry	-	-	20000	20000
	Heifer Pregnant	-	-	-	-
	Heifer non-pregnant	-	10000	35000	22500

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 11 kg of green of fodder followed by 11-12 kg of dry fodder, 2-3 kg of concentrates and about 1 kg 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	9.92	5.39	12.52	8.50	2.74	28.63	1.46	24.02	5.3
Dry	10.70	4.98	10.66	8.20	2.37	27.47	1.12	22.80	6.7
Heifer Pregnant	9.29	4.43	11.29	7.50	1.92	28.42	2.00	24.00	4.0
Heifer non-pregnant	6.86	2.29	12.45	8.36	2.00	29.00			5.5
<1 year	9.89	3.11	9.00	7.93	1.45	26.40			5.0
1-2 Year	9.33	2.67	5.67	7.17	1.00	24.00			6.0
ALL	9.94	5.10	11.98	8.38	2.63	28.48	1.45	23.98	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 11 kg of green of fodder followed by 10 kg of dry fodder, 3-5 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	11.30	6.53	9.97	7.38	3.07	26.88	1.33	23.47	0.0
Dry	11.18	5.50	10.03	7.53	5.00	25.00			0.0
Heifer Pregnant	10.80	2.30	9.80	4.70	2.13	25.00	0.47	27.33	0.0
Heifer non-pregnant	30.00	2.00	10.00	6.00					0.0
<1 year	7.50	7.00	10.50	6.00	2.75	27.00	0.20	28.00	0.0
1-2 Year									0.0
ALL	11.33	6.17	9.98	7.31	3.05	26.82	1.30	23.62	0.0

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 9-12 kg of green of fodder followed by 11-12 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	12.04	4.74	12.09	9.11	2.77	29.11	1.47	25.46	4.8
Dry	8.73	3.71	11.36	9.60	2.50	28.69	2.00	32.00	4.0
Heifer Pregnant	5.00	1.00	13.57	8.07	3.00	28.50			4.8
Heifer non-pregnant	13.50	8.25	12.70	9.40	1.63	28.00	2.00	26.00	4.0
<1 year	8.00	2.80	6.15	8.92	2.67	25.33	0.20	32.00	4.0
1-2 Year	10.00	2.25	11.92	9.69	4.63	25.75			4.0
ALL	11.04	4.41	11.69	9.18	2.81	28.74	1.47	25.67	4.5

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									
	Female									10.0
1-2 Year	Male									
	Female			2.00	10.00					10.0
>2 Years	Male									
	Female	2.25	7.00	1.00	9.33	0.50	32.67	2.25	7.00	7.5

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			1.57	6.29	1.00	25.00			7.3
	Female	1.50	8.44	1.80	6.64	1.03	24.50		1.50	7.6
1-2 Year	Male			1.50	6.63	0.50	20.00			7.8
	Female	1.50	7.25	1.57	6.71	0.71	25.71		1.50	7.9
>2 Years	Male			1.00	6.75	0.50	20.00	0.20	10.00	
	Female	1.47	6.78	1.66	6.68	1.25	26.25	0.20	28.00	7.9

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 50295321 tonnes, 48006943 tones of dry fodder and 5311743 tones of concentrates.

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

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	1735072		6236621	q raaj	7333152		707521
In-milk	654393	4.75	3108367	5.5	3599162	0.64	418812
Dry & not Calve once	265461	3.4	902567	4.02	1067153	0.4	106184
Adult male	238570	4.06	968594	6.03	1438577	0.33	78728
Young stock	576648	2.18	1257093	2.13	1228260	0.18	103797
Indigenous	11589390		41808849		51411030		4487355
In-milk	3090516	4.75	14679951	5.5	16997838	0.64	1977930
Dry	2391572	3.4	8131345	4.02	9614119	0.4	956629
Adult male	3023210	4.06	12274233	6.03	18229956	0.33	997659
Young stock	3084092	2.18	6723321	2.13	6569116	0.18	555137
Buffalo	12976095		56434741		62022601		7358558
In-milk	4447558	5.96	26507446	6.34	28197518	1.05	4669936
Dry	2425462	5.44	13194513	4.95	12006037	0.52	1261240
Adult male	1575280	4.04	6364131	7.47	11767342	0.36	567101
Young stock	4527795	2.29	10368651	2.22	10051705	0.19	860281
Goat	21665939	1.04	22532577	0.2	4333188	0.06	1299956
Sheep	9079702	1.01	9170499	0.2	1815940	0.04	363188
Others	686006	2.35	1612114	6.72	4609960	0.49	336143
Total per day			137795400		131525871		14552721
Per year in tonnes			50295321		48006943		5311743

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	4928000	201703040
B	Forest area and on assumption that only 50% area was accessible for grazing	3.00 (1.50 if considered whole forest area)	2753245	8259735
C	Permanent pastures and other grazing lands	5.00	1669570	8347850
D	Cultivable wastelands	1.00	3831466	3831466
E	Current fallows	1.00	1490507	1490507
F	Other fallows	1.00	1983057	1983057
G	Misc. Tree Crops and Groves not Included in Net Area Sown	1.00	21933	21933
	Total			225637588

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 225638 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 wheat, bajra, paddy, jowar, 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	452682	1.3	588487		0	0.02	9054	0.08	36215
2	Wheat	12430923	1	12430923		0	0.02	248618	0.08	994474
3	Sorghum	349542	2.5	873855		0	0.05	17477		0
4	Bajra/Pearl millet	4163942	2.5	10409855		0	0.05	208197		0
5	Barley	909695	1.3	1182604		0	0.1	90970		0
6	Maize	1404164	2.5	3510410		0	0.1	140416		0
7	Ragi		2	0		0	0.05	0		0
8	Small Millets	3504	2.5	8760		0	0.1	350		0
9	Other cereals	6690	2	13380		0	0.1	669		0
10	Pulses	3418698	1.7	5811787		0		0	0.03	102561
11	Ground nut	1131825	2	2263650	0.7	792278		0		0
12	Oilseeds	6518709		0	0.7	4563096		0		0
13	Sugarcane	458652	0.25	114663		0		0		0
	Total	31249026		37208373		355374		715752		133249

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 severely deficit in green fodder followed by availability of concentrates. The dry fodder availability is relatively better but shot of around 12 per cent of actual 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 tree legumes. Half of the respondents depend on the improved forage and pastures, household left over. Very few household have reported use of grazing land and 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	50295321	225638	50069683	99.55
Dry fodder	48006943	42563746	5443197	11.34
Concentrates	5311743	1849001	3462742	65.19

Table 4.17: Major Sources of Livestock Feed

Sr. No.	Source of Livestock Feed	Number of households reported (%)
1	Grazing land	3.76
2	Crop residues	93.01
3	Improved forage and pasture	52.69
4	Household left over	56.99
5	Tree legumes grown as hedge or any	69.35
6	Feed preservation and storage	10.75

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	61	103910	84	34923	22	32205
Sheep & Goat shed	4	135000	77	22019	1	20000

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)	1.8	1.7	2.3	5.7	5.4
	Female (hrs)	2.8	2.9	3.8	2.1	1.9
Labor cost* (Rs/ year)	Male (Rs)	309.6	306.3	284.0	271.4	289.8
	Female (Rs)	284.6	300.3	238.3	264.3	238.3
Veterinary Cost (Rs/annum.)		1798.73	2789.8	2205.8	1428.6	549.0
Maintenance cost (Equipments, electricity and water charges. (Rs./annum)		1246.15	1094.1	1554.8	1075.0	434.2
Any other cost (Rs)		0.00	3100.0	8000.0	2500	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 crossbred cattle (9.52 lit/day) followed 7.15 lit/day from buffalo and 5.83 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be around half 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	9.52	5.83	7.15	0.54	0.61
	Sales price (Rs.)	26.28	26.10	38.26	22.57	21.79
Dung	Tones	2.81	2.81	3.37	0.47	0.92
	Sales price (Rs.)	3853.26	4221.54	4977.20	1064.29	1592.48
Sales details of animal	Animal weight kgs				35.00	37.23
	Number of animals				6671.43	5863.91
	Sales price (Rs.)					
Any other by-product specify	kgs/animal					
	Sales price (Rs.)					

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 small to medium size of holdings having 2.12 ha of which 82 per cent land was irrigated. It was very surprising and pleasant to note that almost 19 per cent of total operational holdings was devoted to fodder crops, while same was slightly higher in case of land under irrigated condition (19 per cent) as compared to 18 per cent land was under fodder by rainfed land holders. The groundwater the main source of irrigation (more than 7 per cent) 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 lucerne were grown. The fodder cultivation is found to be relatively profitable than other crops. More than the more than 94 per cent selected buffalo and Cattle had average age of more than 2 years while around three fifth of sheet and goats were of same age. The average value of sheet for the age of 2 years and above ranges between as high as around Rs. 8167 in Udaipur and as lowest as Rs. 7100/- in Barmer district while same was for goat of Rs. Rs.6993/- in Barmer and Rs. 5769 in Ajmer district, respectively.

Average value of the buffalo, crossbreed cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 50000/- , followed by Rs. 44000/- for crossbreed cattle and Rs. 32000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Ajmer district. The average feed and fodder consumption of milch animals was ranges between 10- 12 kg of green of fodder followed by 8-11 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 4-7 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 50295321 tonnes, 48006943 tones of dry fodder and 5311743 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 Rajasthan for the year 2016-17 and was estimated to be 225638 thousand 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 severely deficit in green fodder followed by availability of concentrates. The dry fodder availability is relatively better but shot of around 12 per cent of actual 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. Very few household have reported use of grazing land and 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 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 crossbred cattle (9.52 lit/day) followed 7.15 lit/day from buffalo and 5.83 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be around half 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 constraints faced as expected were non availability of adequate irrigation water, high cost of cultivation/production and low return on fodder production, poor Livestock extension services, land is very less therefore cannot afford to put more land under fodder seed/crop production and High cost of fodder seed. The other major constraints reported are non availability of labour and no provision of quality seed by society on credit and non availability of quality fodder seed in market.

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	17	159
2	Non availability of adequate irrigation water	81	186
3	Non Availability of labour	11	186
4	Land is not suitable for fodder production	2	186
5	High Cost of Cultivation/Production and Low return on fodder production	20	186
6	Low price prevails for green fodder in market	6	186
7	High cost of fodder seed	12	186
8	No provision of quality seed by society on credit& Non availability of quality fodder seed in market	8	186
9	Non-availability of Grazing lands	2	186
10	Lack of training facilities	1	186
11	Poor Livestock extension services	20	186
12	Lack of awareness about government programmes on subsidy on seeds	6	186
13	More Laborious	2	186
14	Lack of awareness on production and post harvest techniques	1	186

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, none of the household had 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 (28 per cent), followed by considered it inferior in comparison to fresh one (28 per cent); lack of awareness on production and post harvest management (26 per cent) and more laborious (18 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	0.00	100.0

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	27.6
2	Highly expensive	28.1
3	Lack of awareness on production and post harvest management	26.3
4	More laborious	17.9

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 facilities, Mineral Mixture, fodder seed while one each household had received support of cattle shed subsidy and seed distribution kit. Around 96 percent of households reported that they did not received any support from the government net or dairy (Table 5.4). The top two suggestions made by the selected households were Green Fodder bank should be provided by Govt and Need irrigation facility, while 86 per cent households did not provide any suggestion.

Table 5.4: Benefits getting from the Government to Livestock Production

Sr. No	List of Benefits	Households reported (% to total responses)
1	Cattle facilities, Mineral Mixture, fodder seed	2.7
2	Seed Distribution kit by government	0.5
3	Cattle shed	0.5
4	No benefits received	96.2

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

Sl. no	List of Suggestions	Households reported (% to total responses)
1	Gopalak should be provided with land	0.54
2	Nuisance of blue cow should be controlled	0.54
3	Need to make fodder seed availability	0.54
4	Need irrigation facility	1.08
5	Green Fodder bank should be provided by Govt	10.22
6	Medicine cost is very high and thus require support	0.54
7	Support for Cattle shed by the government	0.54
8	Fodder scarcity problem should be solved	0.54
9	No suggestions	85.48

5.4 Chapter Summary:

The details on constraints faced by the sample households indicate that the top most constraints faced as expected were non availability of adequate irrigation water, High Cost of Cultivation/Production and Low return on fodder production, poor Livestock extension services, Land is very less therefore cannot afford to put more land under fodder seed/crop production and High cost of fodder seed. The other major constraints reported are Non Availability of labour and no provision of quality seed by society on credit and non availability of quality fodder seed in market. The adoption of post harvest techniques plays important role in conservation of dry and green fodders for long period to be used 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, none of the household had 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 (28 per cent), followed by considered it inferior in comparison to fresh one (28 per

cent); lack of awareness on production and post harvest management (26 per cent) and more laborious (18 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 facilities, Mineral Mixture, fodder seed while one each household had received support of cattle shed subsidy and seed distribution kit. Around 96 percent of households reported that they did not received any support from the government net or dairy. The top two suggestions made by the selected households were Green Fodder bank should be provided by Govt and Need irrigation facility, while 86 per cent households did not provide any suggestion.

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 (NDDDB, 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 Rajasthan.

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. Ajmer, Barmer and Udaipur represents three regions of the state viz. Central,

West and South as well as three different ACZs of the state viz. IIA& IIB; IA; and IVA of the state. The reference period of the study was 2019-20 agricultural year.

6.4 About Study Area:

Rajasthan is the largest state having about 10.41 percent of the total geographical area of the country. It supports 5.5 percent of human population and about 11 percent of the country's livestock population. Agriculture and allied activities, however, remain the primary and major economic activity in the state providing livelihood to 66 percent of the state's population. Because of the limited water resources, most of the agriculture production is rain-fed and thus, the livestock sector assumes more importance. Animal husbandry is not only a subsidiary occupation to agriculture but it is a major economic activity, especially in the arid and semi-arid regions of the Rajasthan. Livestock sector development has a significant positive impact in generating employment and reducing poverty in rural areas.

Rajasthan is rich in agro-ecological diversity and has a wide range of unique livestock production systems that have evolved in different regions in accordance with the naturally available resources and needs of the people. This diversity is associated with the choice of species reared; breeds that have evolved, management and feeding practices, health care systems that are closely linked to the natural flora and fauna, and local marketing systems. Development of livestock sector therefore is a critical pathway to rural prosperity. This fact in context to Rajasthan is well established where agricultural operations offer less promising prospects due to extreme geo-climatic conditions and uncertainty of rains. As such livestock operations have expressed their superiority over crop farming in terms of growth, stability, resource conservation and uplifting the socio- economic status of the inhabitants.

Animal husbandry and livestock sector contribute a lot in state economy, and has particularly great potential in rural area. The potential of crop production depends upon huge investment, weather and meteorological conditions. In contrast, animal husbandry and livestock is more stable and requires lesser investments. Livestock and poultry have proved to be life saviour in many distressed conditions, especially in case of drought. The livestock population of the state was 577.32 lakh (2012). Rajasthan is considered as 'Denmark of India'. The total milk production in Rajasthan was 22.43 million tonnes in 2017-18, and ranked second in India. Animal husbandry is a major economic activity contributing approximately 11.19 percent to the total

GSDP of the state in 2018-19. The contribution of agriculture and livestock to total GSDP was estimated to be 35.38 percent, while contribution of livestock to agriculture and livestock together was around 32 percent. Thus, one third of the agriculture sector output comes from livestock sector. The share of GVA from livestock to agriculture sector and livestock has been fluctuating over the period of last more than one and half decade and remains between 20-32 percent. However, the contribution of Gross Value Added from agriculture and livestock to total GSDP has increased from 34.55 percent in 2011-12 to 35.38 percent in 2018-19. Rajasthan accounted for 12.97 percent share in value of output from milk (at current prices) in the country during 2015-16, while its share was 11.15 percent in total value of output from livestock in the country during 2015-16 (GOI, 2018, GSDP).

The state of Rajasthan is rich in livestock wealth. State is blessed with the best breeds of cattle, sheep and camels in the country. The climatic conditions are adverse with scarcity of water for irrigation and erratic rains with very low average annual rainfall. These conditions leave a little scope for crop production and enhance the importance of animal husbandry over the crop production especially during recurrent droughts. The Nineteenth Livestock Census (2012) of India placed total livestock population at 512.1 million, out of which, 57.73 million livestock (11.3 percent) population was in the state of Rajasthan. The state accounted for 6.98 percent share in cattle population, 11.94 percent of buffalo population, 13.95 percent sheep population and 16.03 percent goat population of the country. The district-wise share in total state livestock population figures indicate that Barmer district (9.30 percent) had the highest number of livestock population followed by Jodhpur, Jaisalmer, Nagour, Jaipur, Udaipur, Bikaner, Bhilwara and Pali. These nine districts together accounted for 49.21 percent of total livestock population in the state. Jaipur district had the highest number of in-milk crossbreds and buffaloes. Bikaner had the highest number of in-milk indigenous cattle followed by Jodhpur and Barmer district. In milk indigenous cattle like Tharparkar cattle breed is native of Jodhpur and Jaisalmer districts in eastern region of Rajasthan whereas Rathi cattle breed is reared for dairy purposes in the northern districts of Shri Ganganagar, Bikaner and parts of Jaisalmer which are irrigated or partially irrigated arid zones. The highest livestock and bovine animal density was recorded in Bharatpur.

Rajasthan ranks second among the milk producing states in India, achieving 224.27 lakh MT in 2017-18, which has increased from the 41.46 lakh MT during 1985-86. A numbers of initiatives were taken by the government which could help in improving the milk productivity over the period. 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 against the estimated animals' requirements, feed resources available in Rajasthan are lower. It is estimated that against the requirement of 375 lakh MT of dry fodder, state availability was of 368 lakh MT of dry fodder. It can be seen that during the last two decade (1992 to 2011), shortage of dry matter in the State increased from 29.01 percent of the requirement to 51.88 percent during corresponding years.

In Rajasthan, the livestock keepers have traditionally relied on common grazing lands "gochars", scared groves "orans" and forests. With the growth of mining industry and allocation of community wastelands for biodiesel plantation, the permanent pastures and other grazing land has reduced from 1.9 million ha in 1990-91 to 1.7 million ha in 2009-10. Often layers of white marble dust choke neighbouring grazing land. Rajasthan is a leader in crops like sorghum, pearl millet (bajra), pulses, oil seeds, wheat and rice, all of which in some way or other, form parts of compound livestock feed. Rajasthan also produces non-conventional ingredients, which can be integral part of the feed raw material. Now the dairy farmers are shifting from extensive open grazing system to semi-intensive and intensive stall feeding system. Green fodder is a comparatively economical source of nutrients. However, the availability of green fodder is lower than estimated requirement. In Rajasthan, the area under fodder crop to state gross cropped area increased from 15.93 percent in 2008-09 to 20.26 percent in 2012-13. Bikaner District had the highest area under fodder crops followed by Churu, Hanumangarh and Jaisalmer District.

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 47 years of which almost one third 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 62 per cent were from backward classes, followed by around 18 per cent from open category, 15 per cent from Scheduled tribe and rest of them were from Schedules Tribe. Most of the selected households respondents were male (93 per cent) and very few (7 per cent) were female respondents.
- The selected households had slightly higher experience in farming business (23 years) followed by dairy (22 years) and sheep and goat rearing (11 years). The average family size was found to be 6.7 persons and the highest share of family members were found to be primarily engaged in farming business (39 per cent) followed by 36 per cent in dairy 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 82 per cent households followed by animal husbandry and dairy (13 per cent) and very meagre share of household 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. 135559/- followed by Rs. 48640/- from dairy, Rs 10102/- from sheep and goat rearing. Around 71 per cent of the selected households were found be a no association with any social and cooperative organisations.
- On an average, operational land holdings was estimated to be small to medium size of holdings having 2.12 ha of which 82 per cent land was irrigated. It was very surprising and pleasant to note that almost 19 per cent of total operational holdings was devoted to fodder crops, while same was slightly higher in case of land under irrigated condition (19 per cent) as compared to 18 per cent land was under fodder by rainfed land holders. The groundwater

the main source of irrigation (more than 7 per cent) 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 lucerne were grown. The fodder cultivation is found to be relatively profitable than other crops.
- The details on fodder and feed fed to the animals indicate that the more than 94 per cent selected buffalo and Cattle had average age of more than 2 years while around three fifth of sheet and goats were of same age. The average value of sheet for the age of 2 years and above ranges between as high as around Rs. 8167 in Udaipur and as lowest as Rs. 7100/- in Barmer district while same was for goat of Rs. Rs.6993/- in Barmer and Rs. 5769 in Ajmer district, respectively.
- The average value of the buffalo, crossbreed cattle and Indigenous cattle for the age 2 years and above ranges around Rs. 50000/- , followed by Rs. 44000/- for crossbreed cattle and Rs. 32000/- for indigenous cows. The lowest value of Indigenous cows was reported to be in Ajmer district.
- 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 10- 12 kg of green of fodder followed by 8-11 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 4-7 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 137795 tonnes of green fodder, 132525 tones of dry fodder and 14552 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 Rajasthan for the year 2016-17 and was estimated to be 225638 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 severely deficit in green fodder followed by availability of concentrates. The dry fodder availability is relatively better but shot of around 12 per cent of actual requirement.

- The major sources of livestock feed reported by the sample households are crop residues was major source of the livestock feed followed by tree legumes. Half of the respondents depend on the improved forage and pastures, household left over. Very few household have reported use of grazing land and 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 crossbred cattle (9.52 lit/day) followed 7.15 lit/day from buffalo and 5.83 lit/day from indigenous cows. While the milk yield of small ruminants animals was reported to be around half 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 constraints faced as expected were non availability of adequate irrigation water, high cost of cultivation/production and low return on fodder production, poor Livestock extension services, land is very less therefore cannot afford to put more land under fodder seed/crop production and High cost of fodder seed. The other major constraints reported are non availability

- of labour and no provision of quality seed by society on credit and non availability of quality fodder seed in market.
- 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, none of the household had 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 (28 per cent), followed by considered it inferior in comparison to fresh one (28 per cent); lack of awareness on production and post harvest management (26 per cent) and more laborious (18 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 facilities, Mineral Mixture, fodder seed while one each household had received support of cattle shed subsidy and seed distribution kit. Around 96 percent of households reported that they did not received any support from the government net or dairy. The top two suggestions made by the selected households were Green Fodder bank should be provided by Govt and Need irrigation facility, while 86 per cent households did not provide any suggestion.

6.6 Conclusions and Policy Recommendations:

- Animal husbandry and livestock sector contribute a lot in state economy, and has particularly great potential in rural area. The potential of crop production depends upon huge investment, weather and meteorological conditions. In contrast, animal husbandry and livestock is more stable and requires lesser investments. Animal husbandry contributed over 11 percent to the Gross State Domestic Product. More than 80 percent rural families keep livestock in their households. About 35 percent of the income of small and marginal farmers came from dairy and animal husbandry. In arid areas, the contribution was as high as 50 percent. The sector has potential to create employment in rural areas with least investments as compared to other sectors. Milk contributed to

around 28 percent to the agricultural GDP of Rajasthan 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.

- There is a lack of adequate and genuine data on production and availability of various types of fodder and feed grains. Therefore, competent agencies should be encouraged to generate real time and time-period data on fodder production, feed grain production, land availability for grassland and other pasture grounds, etc. Existing networks involved in data collection for cost of cultivation and other such established sources should be engaged and expanded to collect such real time information as well.
- The fodder crop cultivation was estimated to be more profitable as compared to other competitive or cereals crops grown during kharif and rabi seasons. Therefore, milk union and PDCS need to give more attention of fodder development program.
- Shortage of quality fodder and feed is another major constraint for dairy development. The gap between the requirement and availability of feed and fodder is increasing due to increasing livestock population as against decreasing area under fodder cultivation and reduced availability of crop residues as fodder. Besides common property resources are continuously shrinking due to over grazing of the existing grass land. Therefore, there is a need to frame strategies for sufficient availability of good quality feed and fodder for efficient utilisation of genetic potential of the various livestock species and thereby sustainable improvement in productivity.
- Fodder based cheaper feeding strategies are required to reduce the cost of production of quality livestock since feed alone constitutes 70 percent of milk production cost. To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry crop residues and feed need to be met by either increasing productivity, utilising untapped feed resources, increasing land under fodder cultivation. In parallel, appropriate veterinary research regarding the sources of cost-effective nutritious feed should also be encouraged, tested and informed to the farmers.

- Due to inadequate rainfall during rainy season, the quality and quantity of fodder production gets affected. Thus, there is a need to develop fodder varieties suitable to agro-climatic conditions of the area.
- Efforts need to be made to increase production of quality fodder seeds through necessary incentives, arranging foundation seeds of different high yielding fodder varieties and modern scientific farming procedures. Accordingly more seed plants should be established and farmers should be incentivized and trained to participate in such programmes.
- Efforts are required to increase area under fodder cultivation, especially through use of barren and fallow lands and silviculture. Appropriate resources and technologies need to be made available to ensure quality fodder seed production. Fodder cultivation in degraded land and forest land need to be taken wherever possible with the help of farming community. Round the year availability of quality fodder through promotion of hay, silage and fodder banks, need to be emphasised. Non conventional sources of feeds such as azolla, processed vegetables and fruits waste, etc need to be promoted.
- While fertile lands with assured irrigation are diverted for growing high value crops, large stretches of marginal and wastelands are lying under-utilised across the country. There are also opportunities to introduce fodder as an intercrop or as a soil binder under the watershed development programme.
- Most of the fodder varieties presently released for cultivation, are not the most ideal for cultivation on such low productive lands. Identification of suitable fodder species for such areas and developing suitable cultivation practices are necessary to boost fodder production on marginal and wastelands in the future.
- The role of institutions in fodder development especially district dairy cooperatives needs to be strengthened and there should be dedicated fodder officer to take up fodder development activity on large scale.
- Cultivation of fodder crop is not considered as main/ regular crop and therefore fodder crop mostly receives less coverage and attention in allotment of land. It is thus mostly grown on waste/inferior soil or sometime on bunds and field boundary. Farmers should be explained the benefits of growing fodder seed and fodder. Financial benefits of producing fodder and fodder

- seed should be explained to farmers and can be demonstrated with the help of some voluntary motivated farmer.
- It was observed that a fodder market has been working in Kota city for fodder growers and fodder consumers, whereas good number of marginal as well as small farmers or fodder growers participated and earned a lot of income from fodder cultivation. This kind of market should be developed at other places which have fodder shortage or are under developed area with regards to fodder cultivation. The supply channels should also be extended.
 - During our field visits at the selected study area, we observed that some of the fodder growers had cultivated efficiently the fodder crop and they had keen interest for the fodder seed cultivation which are specially grown in these area. Such good results were observed because some special variety of fodder had been cultivated in this area and had also provided higher yield.
 - Also the support for fodder storage needs to be provided to fodder growers to minimize the fodder losses and to assure timely availability of the same even during off-season.
 - Rajasthan is already bestowed with crucial favourable factors related to animal husbandary and dairy business in the form of ownership of huge number of live stock and many of them are high in endurance. Livestock owners face challenges in the form of harsh climate, difficult arid desert topography, scanty rainfall and fierce summers, scarcity of water for irrigation, among others. However, the courageous farmers can perform very well in terms of producing high yields in dairy business with the support of dairy unions and PDCS..

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Details on Fodder Development Programmes & Seed distributed/Imported

A. 1.1: Ongoing programmes of DAD & F

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
	Guinea Grass	400	10.3	12.05	36.99	0.2	1.0	1.0
Signal Congo	400	0.91	0	3.36				
RFS Hyderabad	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
	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
RFS Kalyani	Maize J 1006		31842	36125	8751	28576	2048	8751
	Ricebean		15800	559	3330	2829	2751	583
	Bidhan							
	Sorghum PC-23		5403	489	120	1422	4054	1865
	Cowpea BL-1,2		5797	3235	2580			
RFS Dhamrod	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	
	Sorghum PC-9	350		3635	659	1145	1400	965
	Sorghum CSV-21F	50		240	419			
	Bajra HC-20	65	440	535	940	0	156	
RFS Hisar	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
	Oats OS6	40	24229	800	7093	7748	0	5000
	Oats Kent	40	5655	2660	21410	2048	125	15000
RFS Suratgarh	-	-	-	-	-	-	-	-
RFS Srinagar	Tall Fesue Demeter	550	130	330	200	6	9	12.5
	Orchard Grass commit	550	8	30	10	0.5	9	1.5
	Orchard Grass-curries	550	7	20	33	0.5	2	1.5
	Orchard Grass - Apunui	550	0	0	0			
	Annual Rye Grass Grassland Manwa	250	338	350	985	1	206	1.5
	Saifoin Melrose Crown Vetch-Local	550	12	30	16	0.5	2	2
	Red Clover	550	38	35	120	1	7	1.5
	Oat-Subjar	55			250			

Source: GOI (2017).

Details on Districtwise Fodder Production, Requirement and Consumption in Rajasthan

Table A2.1: District-wise Area under Fodder Crops in Rajasthan

Districts	Area under Fodder Crops ('000 ha)					Gross Sown area ('000 ha)				
	2000-01	2007-08	2010-11	2011-12	2012-13	2000-01	2007-08	2010-11	2011-12	2012-12
Ajmer	44	19	13	12	27	423	463	775	640	664
Alwar	59	46	34	30	55	785	813	859	854	853
Banswara	3	2	2	2	2	275	361	332	337	340
Baran	4	3	2	2	2	451	528	574	593	629
Barmer	378	357	411	430	417	1,650	1,756	1,979	1,868	1,646
Bharatpur	36	34	27	26	35	563	574	597	591	587
Bhilwara	71	57	36	30	54	410	543	733	624	643
Bikaner	835	612	884	908	1,101	1,465	1,434	1,880	1,884	1,807
Bundi	29	17	18	13	14	344	403	444	461	464
Chiiorgarh	34	23	22	21	27	476	691	520	505	518
Churu	456	347	248	327	608	1,141	1,449	1,575	1,528	1,355
Dausha	33	18	12	11	15	315	338	392	384	378
Dholpur	6	4	3	3	4	159	198	226	230	230
Dungarpur	4	4	5	5	5	128	193	187	200	200
Ganganagar	181	213	217	216	357	907	1,054	1,073	1,107	1,187
Hanumangarh	265	337	310	314	509	883	1,234	1,278	1,220	1,198
Jaipur	120	69	59	53	71	818	896	1,172	1,091	1,013
Jaisalmer	318	330	426	430	500	505	638	878	848	844
Jalor	95	76	61	50	103	700	855	1,126	911	895
Jhalawar	4	3	3	3	4	417	511	570	601	614
Jhunjhunun	80	74	61	66	132	632	648	734	668	644
Jodhpur	256	172	153	158	291	1,205	1,379	1,580	1,516	1,449
Karuli	11	5	4	3	7	271	295	344	340	340
Kota	9	5	5	4	4	426	421	459	462	492
Nagaur	288	136	78	91	217	1,340	1,464	1,859	1,469	1,453
Pali	102	85	46	35	65	570	706	887	702	721
Pratapgarh	-	-	2	2	2	-	-	272	283	291
Rajsamand	10	16	10	8	12	92	143	146	139	140
Sawai Madhopur	27	7	5	4	8	318	330	412	398	400
Sikar	128	87	72	80	134	673	740	847	777	748
Sirohi	31	29	22	18	32	168	226	241	233	230
Tonk	48	18	13	13	19	465	540	715	691	637
Udaipur	14	23	22	21	22	256	386	336	348	342
Rajasthan	3,982	3,229	3,287	3,386	4,853	19,230	22,208	26,002	24,505	23,954

Notes: - Negligible

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

Table A2.2: District-wise Dry Matter (DM) Availability, Requirement and Balance in Rajasthan

Districts	Available / Required / Balance	Dry Matter Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Ajmer	Available	826.9	806.4	452.7	1,070.3	949.4	949.1	967.2	981.2
	Required	1,619.2	2,426.3	1,911.0	2,398.0	2,508.4	2,627.9	2,756.9	2,895.6
	Balance	-792.3	-1,619.9	-1,458.3	-1,327.7	-1,559.0	-1,678.8	-1,789.7	-1,914.4
Alwar	Available	410.8	539.2	1,499.7	2,457.6	2,493.3	2,493.3	2,297.6	2,167.2
	Required	2,478.8	3,195.9	3,627.3	4,073.8	4,187.2	4,310.4	4,443.6	4,587.2
	Balance	-2,068.0	-2,656.8	-2,127.6	-1,616.2	-1,693.9	-1,817.1	-2,146.0	-2,420.0
Banswara	Available	1,838.3	1,937.7	871.0	1,032.1	1,182.9	1,182.9	854.3	1,018.6
	Required	1,600.8	1,956.9	2,261.2	2,383.6	2,405.6	2,433.6	2,466.0	2,502.5
	Balance	237.5	-19.2	-1,390.2	-1,351.5	-1,222.7	-1,250.6	-1,611.7	-1,483.9
Baran	Available	1,035.5	1,201.4	700.5	1,256.8	1,278.9	1,278.9	1,406.5	1,342.7
	Required	1,343.6	1,523.8	1,350.8	1,643.8	1,728.8	1,825.3	1,933.5	2,053.7
	Balance	-308.1	-322.4	-650.3	-387.0	-449.9	-546.5	-527.0	-711.0
Barmer	Available	1,243.1	1,661.6	1,404.1	1,779.8	1,688.3	1,661.6	1,411.3	1,334.6
	Required	2,352.0	2,603.1	2,464.2	2,899.8	3,013.3	3,139.8	3,280.7	3,437.9
	Balance	-1,108.9	-941.5	-1,060.1	-1,120.0	-1,325.0	-1,478.2	-1,869.4	-2,103.3
Bharatpur	Available	1,623.6	1,631.4	1,046.5	1,441.2	1,545.5	1,545.5	1,706.8	1,626.2
	Required	1,841.1	2,179.4	2,711.9	2,070.1	1,978.5	1,898.0	1,828.1	1,768.6
	Balance	-217.5	-5,48.0	-1,665.5	-628.8	-432.9	-352.5	-121.3	-142.4
Bhilwara	Available	801.3	1,007.6	699.4	1,970.8	1,550.7	1,550.7	1,018.9	1,284.8
	Required	2,603.2	3,085.2	2,568.8	2,590.8	2,608.5	2,633.1	2,663.8	2,700.1
	Balance	-1,801.9	-2,077.6	-1,869.4	-620.0	-1,057.8	-1,082.5	-1,645.0	-1,451.3
Bikaner	Available	1,898.6	1,941.6	1,999.0	2,067.4	2,222.3	2,177.1	1,558.7	1,867.9
	Required	2,084.3	2,149.9	2,404.7	2,538.8	2,580.6	2,630.3	2,688.9	2,757.2
	Balance	-185.7	-208.3	-405.7	-471.4	-358.3	-453.3	-1,130.2	-889.3
Bundi	Available	1,476.2	2,307.8	571.7	1,484.8	1,210.4	1,210.4	1,187.3	1,198.9
	Required	1,306.4	1,494.5	1,443.6	1,651.3	1,702.0	1,758.9	1,821.4	1,889.4
	Balance	169.7	813.4	-871.9	-166.5	-491.6	-548.5	-634.1	-690.5
Chittaurgarh	Available	1,211.4	524.1	1,436.4	2,333.2	2,371.4	2,371.4	1,779.7	2,075.6
	Required	2,711.3	2,807.8	2,932.3	3,515.9	3,661.4	3,827.3	4,013.4	4,220.1
	Balance	-1,499.9	-2,283.7	-1,495.9	-1,182.7	-1,290.0	-1,456.0	-2,233.7	-2,144.5
Churu	Available	395.6	474.3	884.1	1,555.0	2,116.8	2,026.3	1,017.5	1,521.9
	Required	1,077.3	1,944.2	1,523.3	1,754.0	1,812.0	1,875.8	1,946.3	2,024.3
	Balance	-681.8	-1,469.9	-639.2	-199.0	304.9	150.5	-928.8	-502.4
Dausa	Available	408.7	483.7	677.5	1,081.6	1,138.4	1,138.4	1,092.9	1,115.7
	Required	1,234.4	1,567.7	1,641.1	1,878.8	1,945.8	2,020.8	2,104.5	2,197.9
	Balance	-825.7	-1,084.0	-963.6	-797.2	-807.5	-882.5	-1,011.6	-1,082.2
Dhaulpur	Available	647.0	610.4	573.7	635.9	679.2	679.2	821.1	544.9
	Required	921.4	1,079.4	1,226.6	1,335.1	1,366.6	1,401.6	1,440.0	1,481.9
	Balance	-274.4	-469.0	-652.9	-699.1	-687.4	-722.4	-618.9	-937.0
Dungarpur	Available	359.5	367.6	375.7	343.3	429.2	429.2	442.0	435.6
	Required	1,186.8	1,448.7	1,641.7	1,760.5	1,785.4	1,814.3	1,846.4	1,881.3
	Balance	-827.3	-1,081.1	-1,266.0	-1,417.2	-1,356.2	-1,385.1	-1,404.4	-1,445.7
Ganganagar	Available	1,980.1	2,367.7	1,289.6	1,820.2	2,231.7	2,231.0	1,636.1	1,933.6
	Required	3,339.7	2,252.5	2,098.4	2,666.2	2,816.5	2,983.5	3,169.1	3,375.2
	Balance	-1,359.6	115.2	-808.8	-846.0	-584.8	-752.5	-1,533.0	-1,441.7
Hanumangarh	Available	1,267.9	1,100.1	1,435.7	1,924.7	2,250.3	2,239.6	1,761.9	2,001.8
	Required	1,987.4	2,100.4	2,129.5	2,414.3	2,482.2	2,555.0	2,633.1	2,716.8
	Balance	-719.5	-1,000.3	-693.8	-489.6	-231.9	-315.4	-871.2	-715.0

Table 2.2 continues...

Districts	Available/ Required/ Balance	Crude Protein Availability, Requirement & Balance ('000 MT)							
		1992	1997	2003	2007	2008	2009	2010	2011
Jaipur	Available	874.0	1,103.2	1,639.3	2,259.9	2,816.5	2,816.4	2,033.4	2,424.9
	Required	3,056.1	3,870.6	4,317.8	5,012.1	5,221.2	5,462.7	5,741.7	6,064.6
	Balance	-2,182.1	-2,767.4	-2,678.6	-2,752.2	-2,404.7	-2,646.3	-3,708.3	-3,639.7
Jaisalmer	Available	1,045.4	1,092.8	1,476.3	1,871.3	1,251.1	1,251.1	1,204.2	1,125.3
	Required	324.4	1,206.8	1,017.4	1,399.0	1,501.2	1,619.1	1,755.4	1,913.3
	Balance	721.0	-113.9	458.9	472.3	-250.1	-368.0	-551.2	-788.0
Jalor	Available	1,009.5	1,157.6	746.7	1,517.1	1,011.5	1,001.5	705.0	1,243.2
	Required	1,277.2	1,941.0	1,954.4	2,277.8	2,348.5	2,423.6	2,503.0	2,586.6
	Balance	-267.7	-783.5	-1,207.7	-760.7	-1,336.9	-1,422.1	-1,797.9	-1,343.4
Jhalawar	Available	1,853.3	1,735.2	794.9	1,333.2	1,276.6	1,276.6	1,455.3	1,365.9
	Required	1,596.6	1,687.0	1,825.8	2,047.5	2,095.3	2,150.2	2,211.4	2,278.3
	Balance	256.8	48.2	-1,030.9	-714.3	-818.7	-873.6	-756.0	-912.4
Jhunjhunun	Available	835.8	826.2	816.6	1,454.9	1,702.8	1,702.6	1,106.4	1,404.5
	Required	1,102.2	1,683.0	1,823.9	2,051.2	2,123.0	2,207.8	2,307.8	2,425.6
	Balance	-266.4	-856.8	-1,007.3	-596.4	-420.2	-505.2	-1,201.4	-1,021.1
Jodhpur	Available	1,195.1	1,312.2	1,280.1	1,829.0	2,002.7	1,976.4	1,379.4	1,013.2
	Required	1,556.8	2,902.5	2,470.3	3,008.6	3,126.5	3,254.7	3,393.9	3,545.2
	Balance	-361.7	-1,590.3	-1,190.2	-1,179.6	-1,123.8	-1,278.3	-2,014.5	-2,532.0
Karauli	Available	794.8	1,071.1	518.4	960.9	1,074.7	1,074.7	1,224.8	1,149.8
	Required	1,532.8	1,552.6	1,513.0	1,738.7	1,795.2	1,857.2	1,924.7	1,998.3
	Balance	-738.0	-481.5	-994.6	-777.9	-720.5	-782.4	-699.9	-848.5
Kota	Available	1,069.9	1,227.8	558.5	960.7	993.9	993.9	1,075.3	1,034.6
	Required	1,034.2	1,208.8	1,196.2	1,441.9	1,503.2	1,570.7	1,644.5	1,724.5
	Balance	35.7	19.0	-637.7	-481.3	-509.3	-576.8	-569.1	-689.9
Nagaur	Available	1,556.3	1,372.4	1,336.2	2,274.6	2,800.9	2,755.9	1,671.2	2,213.6
	Required	2,016.8	3,075.4	2,657.3	3,027.7	3,112.8	3,203.8	3,301.1	3,405.1
	Balance	-460.5	-1,703.0	-1,321.1	-753.1	-311.9	-447.9	-1,629.9	-1,191.5
Pali	Available	1,235.4	968.1	647.1	1,178.1	925.2	924.7	647.9	562.0
	Required	1,642.4	2,213.9	1,940.4	2,235.9	2,309.7	2,391.2	2,480.6	2,578.1
	Balance	-407.0	-1,245.7	-1,293.3	-1,057.8	-1,384.4	-1,466.5	-1,832.6	-2,016.0
Rajsamand	Available	1,086.7	1,284.7	260.9	623.5	439.4	439.3	382.3	410.8
	Required	1,294.0	1,513.7	1,339.3	1,537.0	1,577.2	1,621.3	1,669.0	1,720.3
	Balance	-207.3	-229.0	-1,078.4	-913.6	-1,137.9	-1,181.9	-1,286.7	-1,309.5
S Madhopur	Available	456.6	464.2	414.5	757.7	823.1	823.1	892.7	244.7
	Required	1,137.6	1,277.3	1,223.8	1,294.7	1,321.8	1,352.7	1,387.1	1,424.9
	Balance	-681.0	-813.0	-809.3	-537.0	-498.7	-529.6	-494.4	-1,180.2
Sikar	Available	918.9	1,011.1	1,085.8	1,790.8	2,117.5	2,115.7	1,374.2	1,744.9
	Required	1,562.4	2,235.6	2,432.4	2,807.1	2,909.1	3,023.9	3,153.1	3,298.4
	Balance	-643.5	-1,224.5	-1,346.6	-1,016.3	-791.6	-908.2	-1,778.9	-1,553.5
Sirohi	Available	394.3	347.6	300.9	495.9	443.5	443.4	332.8	388.1
	Required	696.5	865.1	1,033.7	1,145.9	1,172.8	1,202.5	1,234.7	1,269.2
	Balance	-302.2	-517.5	-732.8	-650.0	-729.4	-759.1	-901.9	-881.1
Tonk	Available	614.9	691.9	537.8	845.9	998.4	998.4	698.4	848.4
	Required	1,444.8	1,553.3	1,336.3	1,770.2	1,881.7	2,005.5	2,142.1	2,292.4
	Balance	-829.9	-861.4	-798.6	-924.3	-883.3	-1,007.1	-1,443.7	-1,444.0
Udaipur	Available	1,205.1	1,218.9	1,191.3	1,246.5	1,293.4	1,293.4	1,074.7	1,184.1
	Required	4,083.1	4,031.4	4,134.8	3,927.9	3,882.0	3,846.2	3,817.4	3,793.6
	Balance	-2,878.0	-2,812.5	-2,943.4	-2,681.4	-2,588.6	-2,552.8	-2,742.7	-2,609.5

Source: ICAR-NIANP (2012)- Feedbase 2012, National Institute of Animal Nutrition and Physiology, Bangalore.

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 Rajasthan |
| 2. | Date of receipt of the Draft report | 29 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 Gujarat 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.

Authors
