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Assessment of Feed and Fodder in Kerala

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Institute for Social and Economic Change (ISEC), Bangalore

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Agro Economic Research Centre (AERC), Chennai
For the States of Tamil Nadu, Kerala, Pondicherry and Lakshadweep
Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi
University of Madras, Chennai

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Preface

The state of Kerala is known for its traditional homestead agriculture and livestock rearing. Unlike other states in India, Kerala has a unique and a successful history of land reforms and social development which is also reflected in the agricultural sector. However, agricultural sector in the state is contracting year by year, due to manifold reasons. Livestock rearing is one of the traditional practices among farmers in the state and the sector has cultural dimensions too. Therefore animal rearing is an essential part and parcel of paddy and food grain cropping of the state.

However, with the continuous deterioration of paddy sector in the state, primarily due to the shift in agricultural crops and patterns, livestock integrity and dependency on agricultural sector for feed and fodder has considerably reduced. Unlike many other states, Kerala produces only few food grains and millets which can substantially contribute to feed and fodder. This situation has postulated a forced high reliance on concentrate feed for livestock, than the natural fodder. This in turn has resulted in increased vulnerability of farmers to the ever increasing cost for animal rearing.

Although animal husbandry continues as one of the major means of livelihood among marginal farmers in the state, the problems and prospects of this sector has not been studied well, especially with regard to feed and fodder component. Having a very minuscule stake in the feed and fodder supply to meet a relatively large demand is crucial to handle, especially when the cost of farming is already high in the state, owing to factors such as high wage rate.

Therefore, this study by the AERC Chennai (2020) is an attempt to understand and assess the profile of livestock rearing and the corresponding feed and fodder management by the farmers in Kerala. Through a structured and nationally unified methodology, it puts forth the best picture of animal rearing farmers and the associated feed and fodder silhouette. The study depicts interesting facts such as shift in orientation from animal rearing for milk, to animal rearing for meat, severe lack of awareness about fodder cultivation, regional concentration of animal choices for rearing, etc. In short, this study summarizes both the threats and opportunities of animal husbandry sector in the state.

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We are indebted to Ms Sinila Unnikrishnan, Deputy Director, Dairy Development Department, Malappuram, Mr Jose Jacob, Deputy Director, Dairy Development Department, Ernakulum and Ms Anitha, Deputy Director, Dairy Development Department, Kollam for their wholehearted support and cooperation during the entire course of field survey in their respective districts.

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We sincerely acknowledge our gratitude to all the Dairy Extension officers / Field Officers (or their representatives) in the sample districts and their office for their invaluable assistance for conducting the study in a smooth and organized manner. Their directions in contacting and coordinating the lower level animal rearing farmers at district level were instrumental for this study. We would certainly mention that the members of Milk Cooperative Societies in Kerala and their offices were so admirably cooperative to the study team.

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Chapter I - Introduction to Feed and Fodder in Kerala

1. Introduction

Animal husbandry and dairying is one of the integral parts of agricultural sector and there exists a close link between livestock production and agriculture. This link is positive and multifaceted such as supporting agriculture by providing critical inputs, supplementing farmer incomes, providing low-cost and nutritious food to millions of people, providing animal power which save manpower in agricultural field, maintaining ecological balance, etc.

In India also, livestock sector remains an important sub-sector of the agricultural sector of the economy. Though the share of agriculture and allied sector (including crops, forestry, livestock and fishing) has declined in total Gross Value Added (GVA) of the country since 2011-12, the share of livestock has consistently remained at 4 per cent till 2015-16. Further, the share of livestock sector in the GVA of agriculture Sector (at constant prices) has increased from 21.8 percent in 2011-12 to 25.7 per cent in 2015-16.

However, Kerala marked a small decline in the share of livestock GVA in agriculture sector, i.e. fall from 29.35 per cent in 2015-16 to 29.14 per cent in 2016-17. The agriculture sector in the state as a whole shows the same trend that the share of agriculture sector in total GVA of the State has also declined slightly from 3.18 percent in 2015-16 to 3.08 percent in 2016-17. However, GVA from agriculture sector has increased in absolute numbers.

1.1 Background

India has traditionally been a mixed farming economy with agriculture and livestock playing complementary roles. Therefore, it has been acknowledged that the livestock sector makes an important contribution to food security and poverty reduction. The livestock sector in India contributes to nearly 29.63 percent of total agricultural output and 4.11 percent to the Gross Domestic Product (GDP). The country accounts for the world's largest livestock population, which is roughly 20 percent of the world's livestock population. However, the country has only about 2.3 percent share of the world's geographical area in the sector. India is number one in buffalo population (57 percent) and number two in cattle (12 percent) and goat (20 percent) population among world nations. The desired annual growth of the agriculture sector (four

percent) in the country can also be accomplished by enhancing productivity from the livestock sector. However, it requires a steady supply of fodder for supporting the livestock population.

In the sector, there are a variety of feeds and fodders used for the livestock feeding purposes, which are broadly classified as roughages, concentrates, feed supplements and feed additives. Stagnated area under fodder production and decline in pasturelands are the major challenges faced by the feed and fodder production sector. In addition, replacement of coarse cereal crops, which is one of the main sources of crop residues, by commercial crops is also posing threat to feed and fodder production sector. In India, a mere four percent of the total cropping area fall under fodder cultivation, which has resulted in severe deficit of green fodder (36 percent), dry fodder (40 percent) and concentrates (57 percent). Therefore, the need of the hour is to fulfill this shortfall in fodder (which accounts more than about 55 percent), through crop residues and agricultural by-products.

Fodder deficit in the country may mainly be attributed to our limitations in increasing the area under fodder crops, limited availability of good fodder varieties or hybrids, lack of quality seeds of improved varieties or hybrids, poor quality of dry fodder like paddy or wheat straw, etc. In addition, low priority accorded to investment in fodder production, lack of post-harvest management for surplus fodder, poor management of grazing or pasture lands and inadequate research, extension and manpower support have only aggravated the situation. These situations are apparently more visible in Kerala, in an aggravated manner. For instance, already there is a low priority for fodder cultivation in general, Kerala's high population density induced scarcity of land aggravate the situation further. Needless to say, grazing lands in the state are now limited to those private neighborhood (land) which lays unclaimed for the time being. Similarly, Kerala's acquaintance with cash crops (perennial crops) and spices makes the field not suitable for fodder cultivation per se.

In the milk production sector, feed as an input constitutes 60 to70 percent of the total cost. Henceforth there is an urgent need for assessment of feed and fodder availability, in order to reduce the cost and to ensure quality livestock products. Also, any attempt towards enhancing feed availability and economizing the feed cost would result in an increased margin of profits to livestock farmers. Meeting the requirements of current level of livestock production and its

annual growth in population is a growing concern and it has to be resolved by increasing productivity, utilizing untapped feed resources, increasing land area or through imports. However, in the Kerala context, most of these possible solutions are problematic too. For instance, increasing the land area is almost impossible in the state, while imports from neighboring state like Tamil Nadu is an option. However, this again poses a threat of inconsistent supply against need and fluctuating prices which result in farmers evading the sector. The livestock sector in the state is surviving on concentrates (feeds) than fodder and for which the state is already dependent on neighboring states like Tamil Nadu. Issues pertaining to the inputs for feeds then result in additional or increasing cost for the farmers (Sivagnanam and Pulikkamath 2019)[1].

It's a matter of fact that the accessibility of crop residues and concentrates is directly connected to the food crop production. The food crop sector is showing a positive growth in the recent years, and therefore the crop residue and concentrates feed ingredients availability has also shown a commensurate increase. However, the crop diversification in recent years, especially with commercial and perennial crops, which comes as a replacement for the traditional cereal crops especially the coarse cereals, is likely to have an impact on the availability of crop residues. This situation is alarming because, in animal feed supply, coarse cereals have a major role and four major portions of cereal viz., maize, barley, sorghum, and pearl millet account for about 44 percent of the total cereals. Production of these cereals is stagnating at around 30 million tons per year.

1.2 Livestock Population in Kerala and India

Tables 1.1 and Table 1.2 shows the magnitude and transition of livestock and poultry in the state and in the country respectively, accounted through three consecutive censuses during 2007, 2012 and 2019. In India, the livestock population as a whole has shown a considerable growth over three censuses. However, it also shows a rather stagnate figure of livestock except poultry (cumulated) which have regressed during the period. At the same time poultry has grown on the other hand. Simply, there is about six percent decrease in the livestock except poultry (cumulated) and the same volume has increased in poultry in the state. The trend in the last two

[1] A detailed note on this aspect is appended to this study (see Appendix 1.1)

censuses shows that, out of the total livestock population, poultry constitute nearly 60 percent and other livestock together constitute around 40 percent only. This indicates a change in the livestock composition of the nation and increased demand for poultry products in the consumer market. Out of the total livestock other than poultry, cattle constitute the larger chunk (14 percent) followed by goats (11 percent) and buffalos (9 percent) for the year 2019 and the trend remain same in the previous censuses (2007, 2012) too.

Table 1.1: Livestock and Poultry Population in Kerala (in Lakh)

Livestock Type	Kerala					
	18th Census (2007)	Percent to Total	19th Census (2012)	Percent to Total	20th Census (2019)	Percent to Total
Cattle	17.4	9.03	13.29	4.92	13.42	4.11
Buffaloes	0.58	0.30	1.02	0.38	1.01	0.309
Sheep	0.01	0.01	0.02	0.01	0.01	0.003
Goats	17.29	8.97	12.46	4.61	12.46	3.82
Pigs	0.59	0.31	0.56	0.21	1.03	0.315
Others	…	….	…	….	….	…
Total (Livestock)	35.87	18.61	27.35	10.12	27.93	8.56
Total (Poultry)	156.85	81.39	242.82	89.88	298.18	91.43
Grand Total	192.72	100	270.17	100.00	326.11	100

Source: 19th and 20th Livestock Census & Kerala Economic Review 2019.
Note: Percentages are Author Calculations

Table 1.2: Livestock and Poultry Population in India (in Lakh)

Livestock Type	India					
	18th Census (2007)	Percent to Total	19th Census (2012)	Percent to Total	20th Census (2019)	Percent to Total
Cattle	1990.75	16.89	1909.04	15.38	1934.63	13.39
Buffaloes	1053.42	8.94	1087.02	8.76	1098.52	7.91
Sheep	715.58	6.07	650.69	5.24	742.61	5.34
Goats	1405.37	11.92	1351.73	10.89	1488.85	10.7
Pigs	111.33	0.94	102.93	0.83	90.5	0.65
Others	20.48	0.17	19.88	0.16	7.9	0.056
Total (Livestock)	5296.93	44.95	5121.29	41.26	5367.6	38.6
Total (Poultry)	6488.29	55.05	7292.09	58.74	8518.1	61.34
Grand Total	11785.22	100.00	12413.38	100.00	13885.7	100

Source: 19th and 20th Livestock Census & Kerala Economic Review 2019.
Note: Percentages are Author Calculations

In Kerala, the national trend remains in an intensive form, i.e. the domination of poultry under livestock is as high as 81 percent (2007), 90 percent (2012) and 91 percent (2019) of the total livestock in the state. At the same time, the state mark a considerable decrease in the other livestock from 2007 (19 percent) to 2012 (12 percent) to 2019 (9 percent). Much in the same line of national picture, cattle and goats (4 percent each) are the major proportion of the livestock in the state. At the same time, proportion of buffalos in the state is very negligible, unlike the national picture. In addition, livestock such as sheep and pig have never been a major category at all, over these years. Backed by the boost in poultry sector, the total livestock (including poultry) has grown considerably in the state. It is now the overarching segment of livestock in the state which also indicates the change in consumption behavior of the people. A detailed description of the scenario follows in the sub section 1.2.1.

Table 1.3: Details of Livestock Population in Selected Districts, Kerala and India

District	Buffalo		Crossbred Cattle		Indigenous cattle		Goat	
	Male	Female	Male	Female	Male	Female	Male	Female
Kollam	7785	873	8954	98885	414	2289	24716	124326
Ernakulam	8504	1525	6509	96469	750	4333	20542	126599
Malappuram	14121	956	11101	72720	1416	1798	33507	169892
Kerala	76606	15822	100347	1046481	12258	64151	231334	1006646

Source: 20th Livestock Census 2019, Government of India

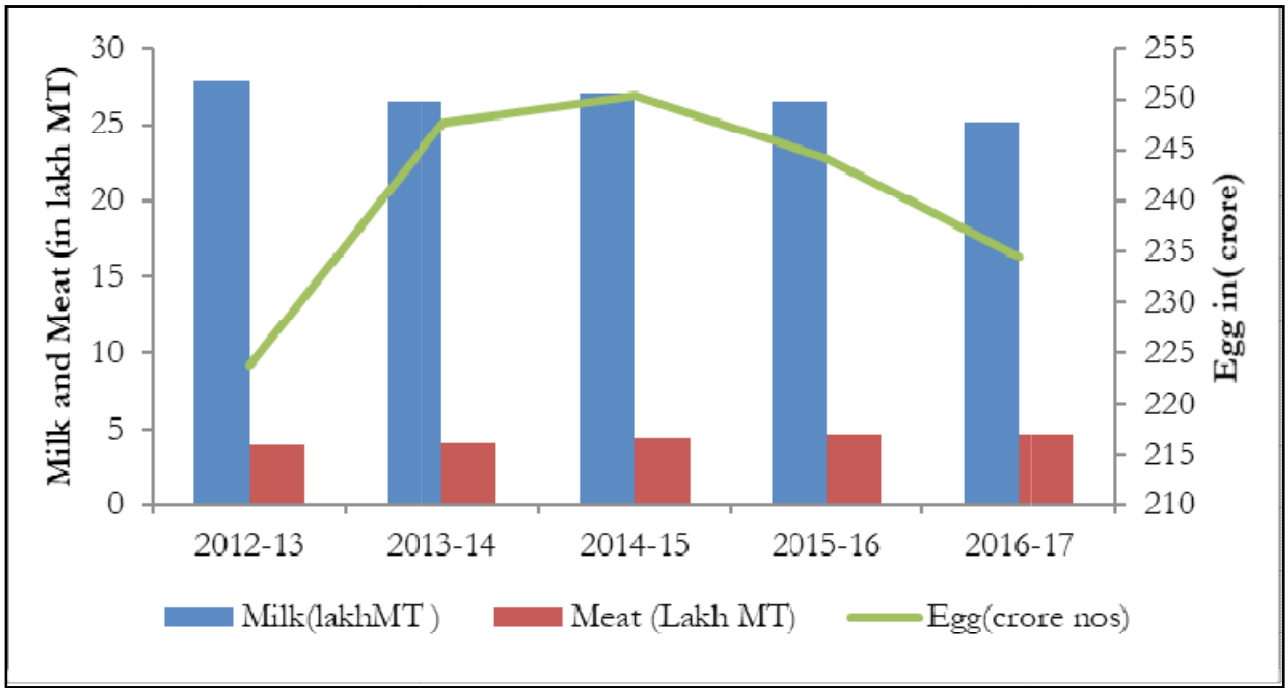
As per the 20th Livestock Census India (2019), the share of Kerala in the national livestock is comparatively less, and the state is not falling under the 'major states' category for this purpose. In fact, Andhra Pradesh and Telangana are the only two 'major states' from south India for this purpose. The Table 1.3 shows that the sample districts livestock in contrast with state and national figures. It is apparent that the female livestock is high in Kerala except for buffalo. This is because that the buffalo rearing in Kerala are mainly meant for meat market, not for milking. On the contrary, female buffalos is high than male buffalos at the national level as in case of all other livestock. In general, buffalo rearing itself is least popular in Kerala and the same applies to indigenous cattle rearing as well. Relatively high density of population and shrinking gazing lands could be the major reasons for this particular situation. On a comparison, buffalos and indigenous cattle rearing requires semi-open and gazing type rearing which is not so easy in the state. Goat population is the highest among the three categories, both in the state and national

levels. However, goat rearing seems popular in northern district of Kerala (Malappuram) and the same trend is visible in buffalo rearing as well.

1.2.1 Major Livestock Products in Kerala

In Kerala, milk, meat and egg are the major livestock products produced from this sector. This would be contrasting from other major states where milk production would top for instance. The reason behind this distinction is the shrinking agricultural sector in the state and its transition to a fully consumer state category. As shown in the Figure 1.1, production of meat has shown a slight increase compared to the previous year, while production of milk has shown a gradual decline. At the same time, egg has shown both up and down swing during last five years, however showing gradual decline since 2015.

Figure 1.1: Production of Milk Egg and Meat during the 12th Plan



Source: Kerala Economic Review 2017.

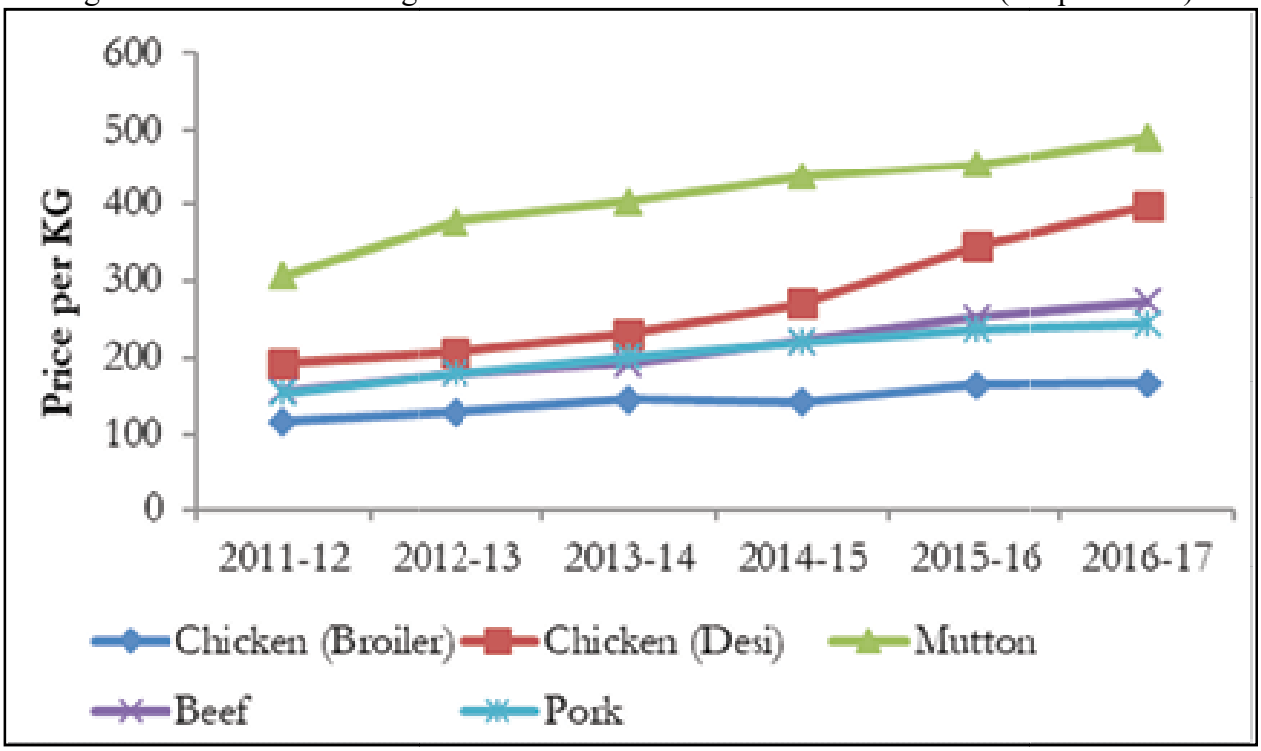
1.2.2 Prices of Inputs and Outputs of Livestock Sector

In a state like Kerala where natural inputs like gaze land are very rare to find, the prices of inputs and outputs associated with livestock are crucial. The series of Figures 1.2, 1.2.A, 1.2.B and 1.3 shows the average price of important inputs and products of livestock sector for the last six years in the state. It is evident from the Figures 2, 2.A and 2.B that all the products recorded increase

in prices during the period. The price of chicken broiler increased by 1.66 percent, chicken (Desi) by 15.30 percent, mutton by 7.96 percent, beef by 8.07 percent and pork by 2.99 percent. The year 2016-17 marks the highest increase in the price of chicken (Desi) (15.30 percent), followed by beef (8.07 percent). When compared to 2015-16, the price of fowl-white egg increased by 13.81 percent, brown egg by 15 percent and duck egg by 22.31 percent during 2016-17. In the same way, the price of cow milk increased by 7.31 percent and buffalo milk by 24.38 per cent during 2016-17 against the year 2015-16. This trend clearly indicates that there is ever growing demand for the products of livestock sector, and especially with poultry.

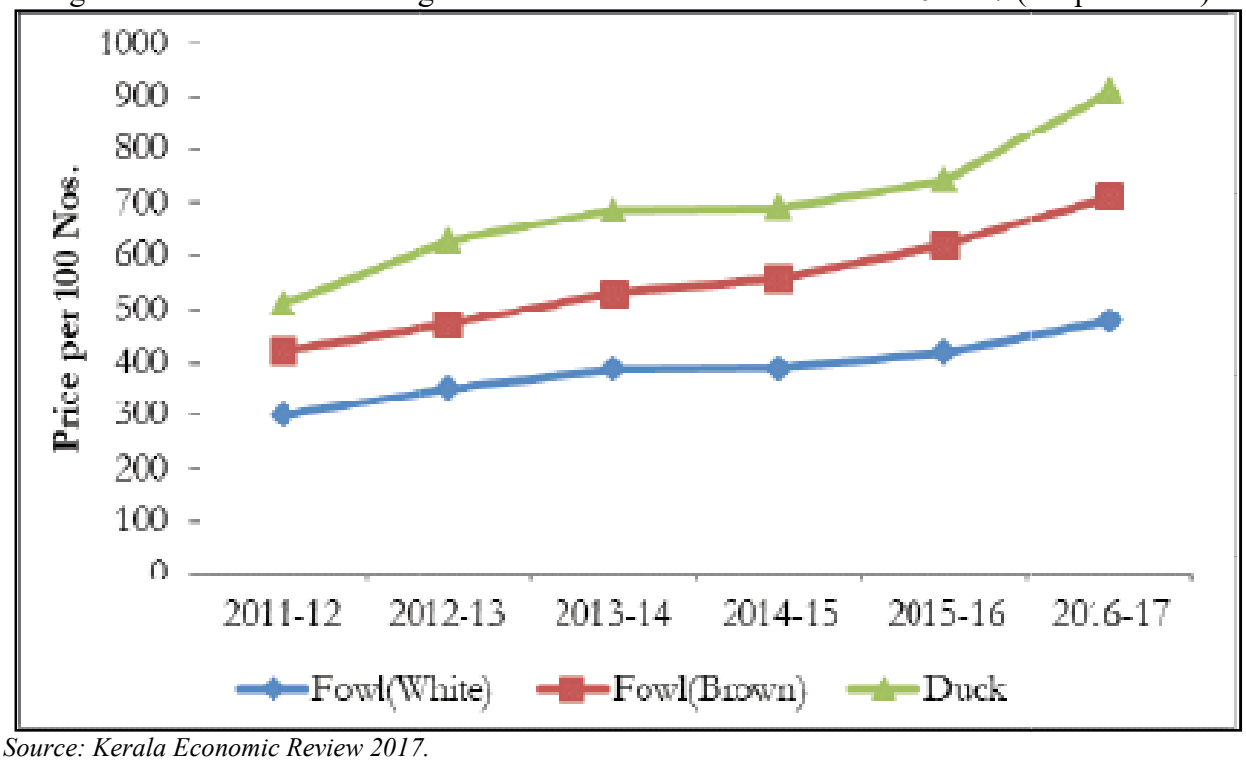
On the other side, inputs for the sector have also marked an increase (Figure 3). The price of straw increased by 13.34 percent and grass by 5.26 percent during 2016-17 and the price of groundnut cake increased by 10.95 percent, coconut cake by 9.25 percent and gingely oil cake by 7.63 percent during 2016-17 when compared to the previous year. This increase in the price of inputs is a serious threat to dairy farming in the state. In indicates a high need to look for the possibility of indigenous source of feeds.

Figure 1.2: Trend in Average Prices of Livestock Products from 2011-17 (Output- Meat)



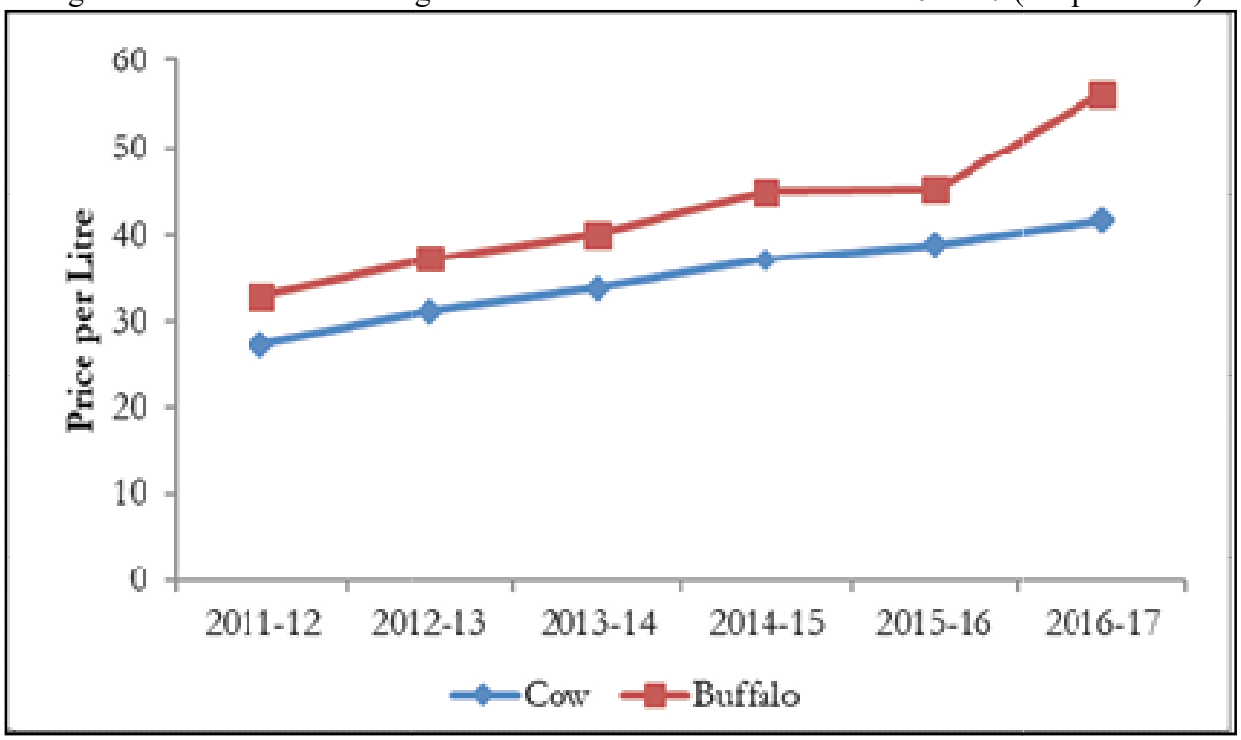
Source: Kerala Economic Review 2017.

Figure 1.2.A: Trend in Average Prices of Livestock Products from 2011-17 (Output- Meat)



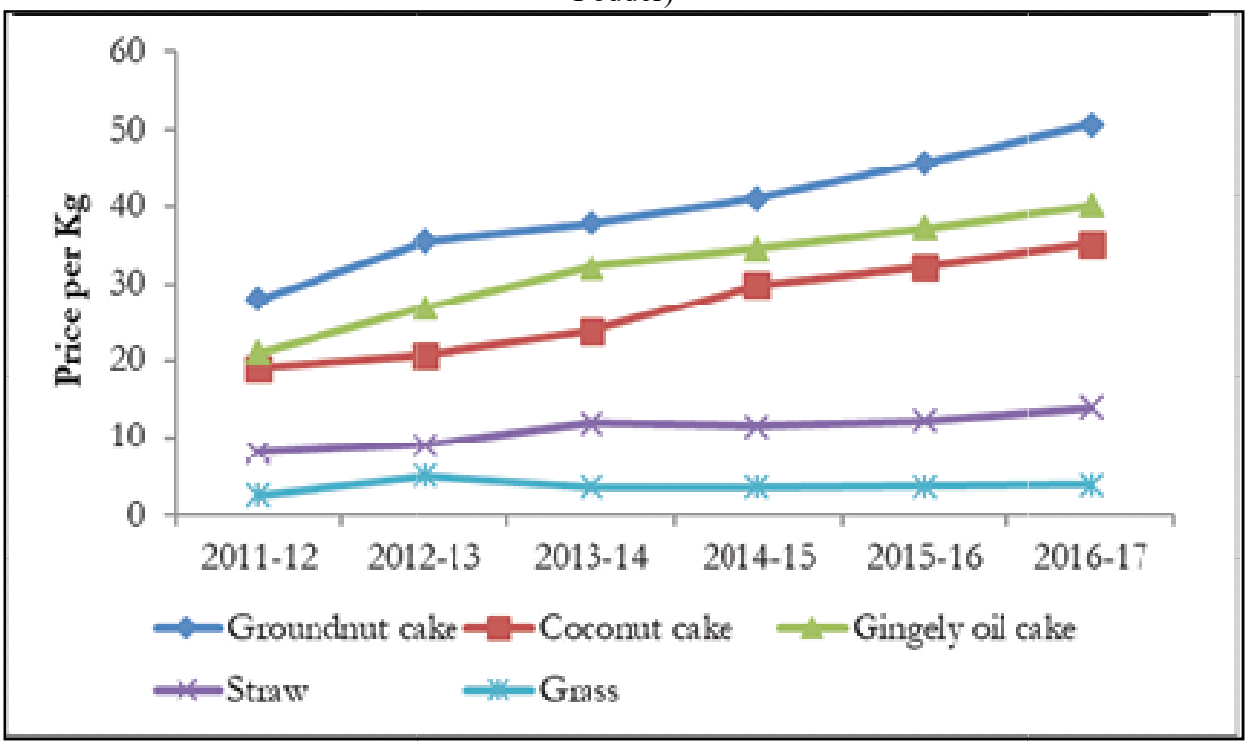
Source: Kerala Economic Review 2017.

Figure 1.2.B: Trend in Average Prices of Livestock Products from 2011-17 (Output- Milk)



Source: Kerala Economic Review 2017.

Figure 1.3: Trend in Average Prices of Livestock Products from 2011-17 (Input- Feed and Fodder)



Source: Kerala Economic Review 2017& Animal Husbandry Department, Government of Kerala

1.3 Feed and Fodder Base in Kerala

Naturally, feed and fodder is a great concern in the state of Kerala with its limited land resources against high dense population, rapid social development induced urbanization. Hence, there exists a critical gap between the need for and availability of feed and fodder which actually affects the livestock and its by-products in the state. As a result, the state market faces a supply crunch of feed and fodder or unusual high in the prices for the feeds, especially of the concentrates. The price of feed and fodder in the state is continuously increasing for many years (Figure 1.3). This situation has had its effect on the dairy sector in the state. Further, it is evident that the prices of fodder (both green and dry) are stagnated in the state for many years, which discourage farmers from doing it (Figure 1.3).

In addition, it is now reported that Kerala Feeds Ltd (KFL) which occupies 40 percent share of the cattle feed market in the state and who are largely responsible for regulating cattle feed prices in the state has incurred operating losses to the tune of Rs 72 crore since 2015 on account of input price increase and social responsibility to support dairy farmers. In the short run, this

situation has been evolved as a result of the popularity of central government's Rashtriya Gokul Mission program in northern India which offers cattle feeds for free. Naturally, demand for cattle feeds in the market shoot up, which resulted in increased demand for raw materials for the cattle feeds production by a number of new firms in the market. Since most of the raw materials for cattle feeds production are not available in Kerala and purchased (about 90 percent) from other states, the rise in price for these inputs has seriously affected the diary sector in the state.

In the peculiar situation of Kerala, it is almost impossible to maintain cattle without giving feeds in concentrate form. Unlike other states like Tamil Nadu, Kerala has no grazing lands and hence the fodder availability such as straw (dry fodder) is very meager. The neighboring state Tamil Nadu has abundant agricultural wastes (such as corn residues) too as it a major vegetable producer which help them in reduced need for concentrate cattle feeds. As a result, the total cost of producing milk in Tamil Nadu state is relatively less. This is the relative context where the Kerala dairy farmers are now hit by the KFL's price hike, in addition to all the other disadvantages pointed out.

The KFL Managing Director said that *"The prices of raw materials like maize, oil-less chaff and rice cake, soybean and molasses used in feed production have gone up by as much as 35 per cent since December. However, KFL effected a hike of Rs 25 per packet since then, which means the company still loses Rs 65 on an average on our products,"*(The Indian Express, 17 April 2019). KFL has no subsidy or grant or any such supporting system as of now.

In the wake of the existing loss of the company, the subsidy scheme for farmers coming under Milma umbrella (Kerala Co-operative Milk Marketing Federation) for Rs. 100 per 50 kg sacks has also been stopped. KLF feeds are the cheapest feeds available in the market with a minimum price of Rs.1045/ 50 Kg sack. At this price, KLF marks a loss of Rs. 10 crores during last year, Rs. 72 crores from the year 2015 to 2018, with an average production of 20000 tons feeds per month. Given such trends, the farmers' naturally demand increased price for their milk. But the solution is not as simple as it looks. As of now, the farmers under Milma are getting Rs.34.5 per litre on an average. This milk is processed and sold at market at a rate of Rs.42 per litre. At the same time, milk from Tamil Nadu costing Rs. 22-23 is plenty in the boarder places and the intermediaries get it on wholesale and sell it in the state for the same market price of Rs.42. Since this practice fetch a very good profit for the agents, the milk price hike in the state may

indirectly help this parallel market which will certainly affect the domestic production and farmers.

Table 1.4: Details of Area under Fodder Crop in Kerala

Sl. No.	Districts	Fodder Crops Area (in Ha) 2017-18	Fodder Crops Area (in Ha) 2018-19
1	Thiruvananthapuram	105	118.32
2	**Kollam**	**160**	**177**
3	Pathanamthitta	177	162.25
4	Alappuzha	178	166.16
5	Kottayam	289	345.08
6	Idukki	1615	1439.37
7	**Ernakulam**	**359**	**406.01**
8	Thrissur	102	125.99
9	Palakkad	1245	1677.92
10	**Malappuram**	**81**	**107.94**
11	Kozhikode	69	64.18
12	Wayanad	624	750.22
13	Kannur	183	156.32
14	Kasaragod	90	106.93
--	**Kerala**	**5277**	**5803.69**

Source: Agricultural Statistics 2017-19, Government of Kerala

Although fodder crops are not limited to fodder grass alone, the only statistics available in the state is on fodder grass alone. The Table 1.4 exhibits the nature of fodder production in each district of the state over last two years (2017-19). It is evident that there is no progress yet in the state, in spite of a number of schemes that the Dairy Development Department initiated, such as commercial and massive fodder production in barren lands and wastelands. There is only about 326 hectare increase in the fodder production in the state over these years which is abysmal for the given livestock growth in the state. The sample districts of the state also show a similar trend of nominal increase in fodder production. Notably, all the northern districts (including Malappuram) in the state show a visible lag in fodder cultivation when compared to southern districts. The district of Wayanad (in northern region) is the only exemption to this matter, which is due to the geographical specialties of the district. It is noteworthy that the northern district (Malappuram) apparently accounts for most number of buffalo and goat rearing farmers among the three sample districts, which results in a severe situation of increased gap between availability of and requirement for fodder per se.

1.3.1 Nodal Agency for Feed and Fodder Development in the State

In order to address this, the authorities now started giving a special focus on fodder and feed production in Kerala to support the development of the livestock sector considering the wide gap in the availability of these two critical inputs. The Dairy Development Department is the nodal agency for fodder development activities in the State. Under the scheme, production and conservation of fodder in farmer fields and Dairy Co-operatives, a new component commercial and massive fodder production in barren lands and wastelands has been initiated. Those lands which are fertile yet remain under-utilized (fallow) under the ownership of progressive farmers, other individuals, Local Self Government Department (LSGD), Public Sector Undertakings (PSU) etc. will be selected and intensive fodder cultivation activities will be taken up (Kerala Economic Review 2017).

As a result, the year 2016-17 witnessed fodder cultivation of about 2050 Ha with 3.28 lakh metric ton of additional production. At the same time, the total production of cattle feed during 2016-17 (3.70 lakh MT) remain stagnated when compared 2015-16 (3.97 lakh MT). Furthermore, assistance for farmers in Azolla cultivation, mechanization of fodder cultivation and harvesting, irrigation facilities etc has been provided in the state. In addition, new innovative fodder development programs under Integrated Dairy Development Program have also been implemented in the districts of Kollam and Ernakulam.

1.4 Brief Review of Literature

Given the thin nature of agricultural sector in Kerala, animal husbandry is a minuscule sector, of which poultry occupies greater share. Naturally, studies pertaining to feed and fodder is rare in the context of the state. However, all India studies are also not a popular domain of research within the agricultural studies in India. One of the recent literatures on potential feed resources for improving livestock productivity is by Amole and Ayantunde (2015) in the context of Niger. They have found that the major factors limiting productivity of livestock systems in the Sahelian zone of West Africa are inadequate quantity and quality of feed resources. Natural pastures, crop residues and agro-industrial byproducts particularly wheat bran has been identified as potential feed resources there. It was revealed that, there is short supply of fertile land and poor feed resources confirming farmers' dependency on feed purchase, which included crop residues, bush hay and cereal bran which make them pressurized. Just like Kerala, declining soil fertility and

declining grazing area together results in booming of off-farm businesses as a major strategy for sustaining farmers households there.

Shortage of feed and fodder supply is not confining to any region or country in the world. Habib et al (2016) shows that there is insufficiency of indigenous feed resources to meet the requirements of livestock and poultry sector of Pakistan. As a matter of tradition, agricultural crop residues constitute the predominant source of feed and fodder in Pakistan as well, and the huge gap in feed availability was dealt with massive import oilseed meals which mainly cater the need of poultry sector. It would be assumed that 95 percent of crop residues are consumed by the livestock (Central Statistics Office India, 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). This Pakistan case of poultry again resembles Kerala case where poultry occupies major share of live stock of the state and the feed requirements of the sector are being met by import from Tamil Nadu. They endorse a rapid expansion in poultry, dairy and feedlot farming in Pakistan and the feed gap will further enlarge. Precisely, that is already the case of Kerala and it is going to be the case of India in future.

India would require an estimated total 526 MT of dry matter, 855 MT of green fodder, and 56 MT of concentrate feed by the year 2020 (Dikshit and Birthal 2010). This estimation was made to throw light on the growing concern of huge gap between demand and supply of feed and fodder in India, just as in the other parts of the world. They have also suggested that this kind of forecasting would help the policy makers to be aware of the gap in the sector and thereby help in designing policy strategy to maximize benefits from livestock production. The estimation of the demand and supply of feed and fodder resources (deficit /surplus) for the livestock in different states of India, the availability of dry fodder, greens and concentrates were usually and popularly studied by Residues to Product Ratio (RPR). However, there are varying approaches within this, such as those given by Suresh et al (2012), Meena et al. (2018) and Dikshit and Birthal, (2010).

The large gap between the requirement and the actual availability of feed and fodder at the national level has replica in Karnataka as well (Bhende, Deshpande and Thippaiah, 2004). They observed that the deficiency in feed and fodder is more conspicuous in arid and semi-arid regions and forecasted that Karnataka may face shortage of fodder in the coming years. In addition, they anticipate a gradual decline of livestock in farms owing to lack of resources and manpower to

make use of unused land under farms and failure of government intervention in seed development and distribution in the state. These are certainly problems in all major states of India, including Kerala. The only difference in Kerala would be that there is no much regional dimension to the problem.

As Kerala is a consuming state with regard to feed and fodder also, John and Manoj (2013a) have analyzed the purchasing pattern and buyer behavior in cattle feed market of Kerala and found that price, quality and convenience are the major factors influencing their purchasing decision. They also observe the scarcity of natural green and dry feed and fodder availability in Kerala. In a consecutive research, John and Manoj (2013b) added that focused studies on product-types and their influence on buying decisions, level of brand awareness among customers, factors influencing brand-shifting etc. have not been undertaken so far. Consecutively, John and Manoj (2014) continued their research on purchasing behavior of cattle feeds in Kerala with regard to Compounded Cattle Feed (CCF) and found that CCF is gaining momentum and acceptability although it is not a relatively new product in the state.

1.5 Need for the study

It is a well known fact that the share of agriculture sector in total GDP is declining for past several years. However, the live stock sector scenario is different and its contribution to the agriculture sector has been increasing over the years. Although the livestock population marks a significant growth, the complimentary increase required in the feed and fodder resources could not happen due to the heavy pressure of commercial crops. There is a paradoxical situation that the area under fodder has been shrinking and the consumer nutritional awareness, preferences and changing lifestyle indicate increasing demand for quality value-added milk and other livestock products. The expected projection of India's population growth also indicates the increasing requirements dietary needs where livestock sector has a key role to play, ICMR perceives. Considering the demand for milk and milk products, land under fodder production needs to be doubled or else India has to import milk from other countries.

The concomitant demand for high-quality feed and fodder to sustain high production and produce quality products in the livestock sector is yet to be addressed adequately. Sufficient availability and efficient use of feed resources are fundamental to tap the potential productivity

of livestock sector in the country. Since feed and fodder security is vital to livestock management, knowing the extent of use, conservation and productivity enhancement, assessment and forecasting of livestock feed resources are crucial for effective planning and policymaking in this regard. Therefore the findings of this study demonstrate the overall shortage of all types of feed resources and intra-state variation in the requirement and availability of feed and fodder resources. Keeping this background, the study examines demand, supply, and a deficit of feed and fodder production in the country.

1.6 Objectives of the Study

1. To estimate the area, production and productivity of major green and dry fodder crops in Kerala.
2. To study the growth pattern of major livestock population in Kerala.
3. To assess feed and fodder availability, requirement, deficit/surplus to improve livestock productivity in Kerala.

1.7 Methodology of the Study

The study is conducted in the states of Kerala as suggested by Ministry of Animal Husbandry, Dairy and Fishery, Government of India. However, the Ministry of Agriculture and Famers Welfare, Government of India is conducting the study for them and the Institute for Social and Economic Change (ISEC) Bangalore has been accorded as the nodal agency to coordinate the study at the national level. In the same line, Agro Economic Research Centre (AERC) Chennai, University of Madras has been accorded to take up the state specific study in Kerala. Thus, the overall methodology and sampling frame of the study follows the guidelines given by the national coordinator – ISEC Bangalore.

The present study confines its scope to Kerala state and the study is based on both primary data and secondary data. The secondary data on livestock population are compiled from different quinquennial Livestock Censuses of India. The Census provides livestock population by region, species, sex, age, and purpose. For the present study, state and district-wise data on livestock population are collected from the Department of Animal Husbandry and Dairying, Government India for different species viz., cattle, buffalo, sheep and goat for the census periods 2007, 2012 and 2017. Further, secondary data on the area under fodder are collected from various issues of

Land Use Statistics and also from the Departments of Animal Husbandry and Dairy Development Departments of Government of Kerala. In addition, the Kerala Economic Review (KER) reports being published annually from the Kerala State Planning Board (KSPB), Thiruvananthapuram has supplemented the data requirements.

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. The picture of Kerala in this regard is even worse, that the area under fodder crops is just 0.22 percent of total cropped area in the state.

In order to estimating the demand and supply of feed and fodder resources (deficit /surplus) for the livestock in Kerala, the availability of dry fodder, greens and concentrates were calculated using a suitable extraction ratio, also called Residues to Product Ratio (RPR), as suggested by the coordinating centre – ISEC Bangalore. The quantum of green fodder, dry fodder, and concentrate feed was converted into dry matter (DM) by applying a factor of 0.25 for green fodder, and 0.90 for dry fodder and concentrate feed (Suresh et al 2012). Crop residues and concentrates from various cereals, pulses and oilseed were estimated based on their conversion factors (Meena et al 2018). The factors for conversion of DM from each source into total digestible nutrients (TDN) were 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) were 0.073, 0.016 and 0.180 for green fodder, dry fodder and concentrate feed, respectively (Dikshit and Birthal 2010). The major fodder crops like maize, sorghum, pearl millet, Egyptian clover, Lucerne, cluster bean, etc., were considered. The area under fodder crops was calculated to be 8.9 million ha, and the fodder productivity was estimated by using the weighted average of 40.93 ton/ha, considering the minimum yield of each fodder crop[2] (Handbook of Agriculture 2005).

[2] A detailed explanation on this methodology is appended to this report (see Appendix X.1)

In addition, a primary survey was conducted to understand and analyze the demand for and supply of feed and fodder in the state, by employing a sample survey method. The reference period of the study is 2018-19 agricultural year. The household level primary survey covered the socio-economic profile of the livestock farmers and dimensions of availability, production and practices of feed and fodder resources for their livestock. To meet the objectives of the present study, the primary and secondary data will be collected, scrutinized, tabulated and analyzed by employing various analytical tools.

1.7.1 Sampling Framework

The sample districts for the study have been selected on the basis of livestock population, as reported in the livestock census. A proportionate sampling technique is applied to determine the sample size in districts of the state. In order to select the sample districts of the study, the district wise distribution of livestock population has been collected, and ranks have been assigned to those districts on the basis of the size of the population of cattle, buffalo, sheep and goats separately. Then the average of these ranks of each district has been calculated. The top three ranks (districts) have been selected, while controlling for the regional representations. In this way, the sampling frame shown in Table 1.5 has been used for the study[3].

Table 1.5: Sampling Frame Work in Kerala **(**Basic)

AERC	States	Districts	Cattle	Buffalo	Goat & Sheep	Total
AERC Chennai	Kerala	Ernakulam (Central)	44	40	40	124
		Malappuram (North)	34	62	44	140
		Kollam (South)	42	18	36	96
		Subtotal	120	120	120	360

Source: ADRTC, ISEC Bangalore

In every selected state (including Kerala), total of 120 cattle rearing farmers, 120 buffalo rearing farmers and 120 sheep and goat rearing farmers will be surveyed with a pre prepared questionnaire. The number of farmers surveyed is mainly based on proportion of cattle, buffalo and sheep and goat population existing in the district i.e. in selected districts of every state, based on proportion population, sample size is determined. Villages are selected based on the density of the animal population details given by the district animal husbandry department. The cattle

[3] A detailed national sampling framework is appended to this report (see Appendix 1.2).

rearing farmers includes both cross breed and indigenous cows, bulls and oxen or calves, if farmer rearing all kinds of animals means he will be considered as more than one sample.

However, since the sample farmers are composite in nature (i.e. they can be buffalo rearing, cattle rearing and goat rearing at the same time), the sample frame has been modified during the field work as shown in Table 1.6. We have collected 440 samples in total against the required 360 as per the framework given in Table 1.5. However, we have collected the samples in a different distribution among buffalo rearing, cattle rearing and goat rearing farmers. This is primarily because we have conducted the field survey under the supervision of Dairy Development Department, Government of Kerala where milking animals are their primary focus.

Table 1.6: Sampling Frame Work in Kerala (Modified)*

AERC	States	Districts	Cattle	Buffalo	Goat	Total
AERC Chennai	Kerala	Ernakulam (Central)	68	40	54	162
		Malappuram (North)	65	57	50	172
		Kollam (South)	56	13	37	106
		Subtotal	189	110	141	440

*Source: AERC Chennai, *Reframed after Field Investigation*

As already discussed, in Kerala, buffalo rearing and goat rearing are primarily meant for meat market which comes under the Animal Husbandry Department, Government of Kerala. Therefore, we have collected excess samples in cattle and goat rearing categories while samples in buffalo rearing are a little less than what we have originally targeted. However, the total sampling frame across three districts - Malappuram (172 against 140), Ernakulam (162 against 124) and Kollam (106 against 96) - is maintained up to or over and above the target. In the Table 1.6, black color samples indicates the standard sample, green color indicates excess sample and red color indicates shortage sample as per the standard sample given as per Table 1.5.

Further, although sheep rearing farmers were targeted in the national methodology arch (Table 1.5), they have not been considered in the study as sheep population or rearing is a negligible proportion of livestock in Kerala. According to the 20th Livestock Census (2019), there are only 26 sheep together in all the three sample districts of the study. The distributions of this 26 sheep are as two in seven in Kollam, two in Ernakulam and 17 in Malappuram. Given this, the methodological framework of representation of each category of livestock cannot be equated

with this little population of the sheep in the state. Therefore the study limited goat and sheep rearing farmers to goat rearing alone.

Chapter II - Socio-Economic Dimensions of Farmers

2.1 Introduction

The geography of the study area is encompassing all the three major regions in Kerala. The sample districts are being drawn in such a way that all the three regions have representation. Thus, Kollam represent Southern Kerala (erstwhile Travancore region), Ernakulam represent Central Kerala (erstwhile Cochin region) and Malappuram represent Northern Kerala (erstwhile Malabar region). Therefore it is apparent that the demography of these places will vary considerably. For instance, human development attainments in Southern parts of Kerala are way better than those of Northern Kerala. Similarly, agricultural patterns in different districts vary across state although the geographical changes among them are not much different. This is because of the varying socioeconomic dimensions of the population. However, all these attributions need to synchronize in the sample population of the study. This chapter explains such details of demographic and socioeconomic profile of the sample households, which is composite and representative of all these features.

2.2 Socioeconomic Profile of Sample Households

The farmers included in the survey can be those who are doing land farming and animal husbandry at the same time of just animal husbandry alone. Further, they can also be cattle rearing, buffalo rearing and goat rearing at the same time or just dealing with any combinations two or just dealing with one type animal rearing. So, basically farmers who are falling under the purview of animal husbandry sector (limited to cattle rearing, buffalo rearing and goat rearing) are the focus of this study. Although sheep rearing farmers were targeted in the national methodology arch, they have not been considered in the study as sheep population or rearing is a negligible proportion of livestock in Kerala (As per the 20th Livestock Census 2019, there are only 26 sheep together in all the three sample districts of the study).

The Table 2.1 shows the socio-economic profile of the sample households who are farmers dealing with animal husbandry. It is evident from the table that the average age of farmers is 53, which in turn implies that the animal husbandry too is vested in the hand of old generation farmers. As a number of recent studies rightly indicates (Sivagnanam, Pulikkamath, Priya and Mooventhan, 2018; Sivagnanam, Priya, Mooventhan and Pulikkamath, 2017), the younger -

Table 2.1: Socioeconomic Profile of the Sample Households

Sl. No	Particulars	Number / Percentage
1	Average age of the sample households	53.25
2	Education level (%)	
	Illiterate	3.22
	Primary School	13.36
	Middle School	16.12
	High School	48.38
	Higher Secondary School	5.52
	ITI or Diploma	7.83
	Graduate	4.60
	Post Graduate & Above	0.92
3	Caste (%)	
	General	48.38
	OBC	43.31
	SC	5.52
	ST	1.84
4	Gender (%)	
	Male	76.49
	Female	23.50
5	Average family Size (No.)	4.79
6	Average Income (Rs)	496143.46
i	Agricultural Income (Average)	416236.87
ii	Dairy Farming Income (Average)	65142.39
iii	Goat Farming Income (Average)	13496.91
iv	Other Income (Average)	1267.28

Source: Primary Survey

generation in the state is not at all visible in the agricultural and allied sectors in the state. Comparatively higher education and large outmigration from the state are often referred as the reasons behind it. Further, comparatively less landholding per head, high wage rate for agricultural labors, high density of population are adding fuel to the diversion from agricultural sector to other sectors. That's how animal husbandry is also largely vested in the hand of old generation farmers alone in the state, which is of course not a good indication. Strongly backed by the renowned achievements of Kerala in literacy and education, educational profile of the farmers is impressive. Around half of the respondents (48.38 percent) have completed their high school education and around 13 percent of farmers have completed their higher secondary schooling or an equivalent course like Diploma. However, the highly educated farmers'

proportion is as tiny as one percent with Post-Graduation and five percent with Under Graduation. Thus, approximately 70 percent of the farmers are qualified high school and above.

The social class background of the farmers in the survey indicates that the majority of the population belongs to the general category people. Here the general category mostly refers to Christian community in the state and they constitutes around half of the sample. Similarly, Other Backward Community (OBC) constitutes another 44 percent of the sample who are mostly Muslim, Ezhava, Latin Catholic and some sub castes of Nair communities in the state. Notably, farmers belonging to Scheduled Caste (SC) and Scheduled Tribe (ST) are very less, that is six and two percent respectively. The gender attributes of the households shows that about 77 percent of the farmers are male, indicating the typical patriarchal lines in the agricultural sector. Although the animal husbandry is a backyard matter (homestead) in most of the households, and animal husbandry chores are being borne by women in the family for most of the times, they are not being endorsed in the mainstream. Even there are instances where the female respondents (whom we met at the field while collecting data) insisting on putting their spouse name as 'farmers in records'.

The average family size of the farmer as 5 on an approximation indicates that the farmer families are not a typical nuclear family where couples and one or two kids are living. We have to read it in the line that the fertility if Kerala is just 1.7 (Government of India, 2017) due to early success of family planning in the state. Therefore the appended size of an average family indicates an increased member usually in the form of parents or grandparents who are dependent. This can either be attributed to the senior member of the family who remains of farmer while his children engages in other source of income which results in wellbeing of the family by multiple source of income; or the farmer is mid aged and he is accommodating the old aged parents which results in economic burden as there is no alternate source of income and only one mean of livelihood.

The average income of the sample farmers indicates that their earnings are not bad. However, the flipside of this particular situation is that, most of the farmers are dealing with cash crops such as rubber. This kind of perennial crops need huge initial investment and features comparatively low maintenance cost for next 20 to 30 years while fetching a moderate yield. Notably, non-cash crop cultivation among farmers are very less, and the details of the same are explained in the next

chapter. The table shows around Rs. 4.9 lakhs as the average income from all sources. However, income from agricultural activities alone is Rs. 4.1 lakhs and dairy farming gives an average income of Rs. 65000 while goat farming fetches Rs. 13000 per annum. It shoes that the income from animal husbandry in general is very less in a comparison with cash crop farming. Further, it is also an indication that the animal husbandry sector remains a backyard matter (homestead) and the commercialization of the sector is far away.

2.3 Occupational Dimensions of Sample Households

Experience of doing farming is crucial in agricultural sector because the sector has strong underpinnings with cultural practices, climate changes, seasonal variations, local knowledge, etc. Therefore having experience is a bonus in the animal husbandry sector and it may increase the chances increased earnings by avoiding potential threats learned through experiences. The Table 2.2 demonstrates the occupational profile of the sample farmers, including experiences for that matter. It explicitly shows that the higher average experience of farmers is in the dairying sector, which is 18 years. It explains that the dairying, especially cattle rearing, is a traditional mean of livelihood among farmers are the practice is usually inherited. Although dairying includes both cattle and buffalo rearing under its umbrella, it is mostly ‘cow rearing’ in Kerala. Buffalo rearing is rare and primarily meant for meat market, not for milk market. Although the farmers are aware that the chores of buffalo rearing are comparatively less and it can fetch more income, they are not in it as a matter of norm or culture or heredity.

The average experience of the farmers in traditional land farming and goat rearing are the same which is 11 years. Therefore, it draws an interesting line that, an average cattle rearing famer need not to be a traditional (land involved) farmer. That’s where the animal husbandry sector in Kerala is a backyard matter (homestead) also. Goat rearing in the state again primarily meant for meat market. However, farmers usually do not prefer goat rearing over cattle rearing because it fetch no money from milk (a regular source of income) and requires a regular routine of green fodder in take at least. It can be the reason behind the hand in hand average experience of famers in land farming and goat farming, where the green fodder in take can be found from the wastages of agricultural land. Relatively less grazing land in the state and high density of population may again prevent farmers from goat and buffalo rearing (for meat market) which have to be intensively grazing oriented to reduce cost.

Table 2.2: Occupational Profile of the Sample Households

Sl. No	Particulars	Number / Percentage	
1	Average Experience (Years)		
	Farming Experience (Years)	11.01	
	Dairying Experience (Years)	18.07	
	Goat rearing Experience (Years)	11.02	
2	Average No. of Family Members Engaged in Farming and Animal Husbandry	4.12	
	Farming	1.97	
	Dairying	7.80	
	Sheep & Goat rearing	2.48	
3	Occupation	Primary	Secondary
	Cultivator	7.83	21.19
	Animal Husbandry& Dairying	87.56	16.58
	Agricultural Labor	0.92	---
	Non-farm Labor	1.38	0.46
	Own Non-Farm Establishment	-----	-----
	Trade	1.38	-----
	Employee in Service	0.92	-----
4	Member of Social & Cooperative Organization	Yes	No
		89.40	10.60

Source: Primary Survey

In support of the fact that the cattle rearing in Kerala is more of a backyard matter (hometsead) and women intensive, the Table 2.2 also indicates that almost 7 of the family members are engaged in dairying. It implies that the women and children (and elderly people if applicable) in the family are certainly taking up the chores related to dairying such as milking, milk distribution, finding green fodder locally (no cost involved), grazing etc. At the same time, land farming and goat rearing fetches involvement of two family members on an average.

Among the total farmers surveyed, a lion share (83 percent) of them is doing animal husbandry and dairying as their primary occupation. The traditional cultivation as the primary occupation constitutes only about 8 percent of the total respondents. However, regarding secondary occupation, majority (22 percent) are traditional cultivators followed by animal husbandry (17 percent). It is also noteworthy that only about 38 percent of the total respondents are reported with both primary and secondary education, which implies that most of them are engaged only with primary occupation alone. Interestingly, about 90 percent of the farmers surveyed are a

member of any of social or cooperative organization. It indicates the stronghold structure and functioning of dairy cooperatives in the state. Further, it may be the factor of attraction for farmers to prefer on dairying over others.

Chapter III - Estimation of Area, Production and Productivity of Fodder and Feed Crops

3.1 Introduction

The feed and fodder affairs are inseparable from the nexus of agricultural and social life of the people involved in animal husbandry. Like any other segment of agricultural sectors, feed and fodder crops also have influences of various factors including land availability and choice of crop by the farmers. Understanding the agricultural scenario of the farmers doing animal husbandry is therefore crucial for any further step towards improving feed and fodder sector in the state. This chapter summarizes the agricultural and animal husbandry patterns in Kerala, along with details pertaining to each segment of animals viz cattle, buffalo and goat. Further, capital and recurring investments in the sector and yield from the sector are also explained in this Chapter. Therefore it offers a glimpse of socioeconomic costs and their returns in the state with regard to animal husbandry and allied feed and fodder.

3.2 Land Use Pattern

Land is a prerequisite for agricultural sector and any sort of farming activity. Although animal rearing is not essentially dependent on possession of land and size of land as in case of cultivation, there is a minimum land requirement for livestock rearing. In addition, feed and fodder production by the farmers is definitely a function of land availability with the farmer also. Given the thin land availability in the state and the non-food nature of fodder crop, land availability and usage pattern has crucial role in deciding the feed and fodder component in the state. The Table 3.1 depicts a summary of land profile of the farmers along with the profile of irrigation facilities. On the whole, un-irrigated land is almost nil in the state, indicating that the farm lands in the state perhaps holds water resources alongside.

Among the categories of land possession, own has the maximum share in such a way that a farmers holds around 1 acre land on an average. In addition, one tenth of the owned land are being leased in by the farmers on an average and there is about half an acre land as uncultivated per person. With that, the average net operated area by farmer is merely 0.75 acre. Notably, fodder cultivation among farmers is trivial, as the share reported is well less than 1 percent.

Similarly, public grazing land availability in the state is also reported trifling, which indicate the usually expected green fodder profile is completely missing in the state.

Table 3.1: Landholding Pattern and Source of Irrigation of Sample Households

Sl. No	Particulars	Irrigated (Acres)	Irrigated (Average Acres)	Un-irrigated (Acres)	Un-irrigated (Average Acres)	Total (Acres)	Total (Average Acres)
1	Owned land	237.89	1.10	0	0	237.89	1.10
2	Leased in land	23.9	0.11	0	0	23.9	0.11
3	Leased out land	5	0.02	0	0	5	0.02
4	Uncultivated land	106.425	0.50	0.5	0.002	106.92	0.50
5	Net operated area	160.19	0.74	0	0	160.19	0.74
6	Area under fodder crop	11.3	0.05	0	0	11.3	0.05
7	Village agro forestry	0	0	0	0	0	0
8	Village grazing land	1	0.005	0	0	1	0.005
9	Others	(In Number)		(In Percentage)			
I	River bank	11		5.07			
ii	Neighbors	121		55.76			
10	Source of irrigation	(In Number)		(In Percentage)			
i	Canal	7		3.23			
ii	Bore well	5		2.30			
iii	Dug well	199		91.71			
iv	Tank	0		0			
v	Others	6		2.76			

Source: Primary Survey

Given the scenario, the grazing requirement in the state is predominantly met through land in neighborhoods (unclaimed or unused temporarily) as almost 56 percent farmers reports the same. Subsequently, small river banks in the state also cater the need for grazing livestock, however limited to a small 5 percent of farmers. This proportion of using river banks as grazing field remains small primarily because those river banks are also mostly private properties in the state. It was reaffirmed that 92 percent of the farmers in the state report dug well as their source of irrigation. Dug wells (Open wells) are the major groundwater extraction structures in Kerala and their density is perhaps the highest in the country, that is 200 wells per square kilometer in the coastal region, 150 wells per square kilometer in the midland and 70 wells per square kilometer

in the high land (Personnel & Administrative Reforms Department, Government of Kerala 2013).

3.3 Cropping Pattern

The cropping pattern of the farmers has as important role as land availability in determining the availability of feed and fodder for livestock. Table 3.2 portrays an overview of cropping patterns in the state across various seasons. Although more than 90 percent of the farmers have their own dug well to irrigate and almost 100 percent of the landholdings are falling under 'irrigated' category, there is no summer cropping in the state. This has a flip side too, as the majority of the crops in the state are perennial or annual in nature. Although tapioca and fodder are reported here under kharif and rabi seasons, they are actually annual. These seasonal harvest and spilt in yielding in the state is reported as a result of mixed cropping and differing seasons of planting the saplings. The farmers with the given tiny land, always make the annual crop planting in such a way that they can harvest it at least twice in a year, which doesn't means they confine to that particular season's cultivation. On the other hand, commercial banana cropping shows a regular annual trend due to varying reasons including its perishable nature and huge demand in annual special markets such as Onam festival.

Perennial crops are the popular crops in the state both in terms of number of crops and earning per annum. Expectedly, the highest average cropping area is accounted for cash crops – pineapple and rubber – that are 2 and 1.5 acres respectively on an average per person. This alone gives a clear indication of the worst fodder availability in the state. Rubber being a perennial and 100 percent non-edible crop has nothing to contribute to feed and fodder sector, and the crop even deter the growth of natural greenery in the field. Leaving those few years in infancy of rubber crop, the land under rubber will produce only rubber for next 20 to 30 years. Among the crops listed in the table, rubber has the second highest average total cost and total return, fetching about Rs.55000 per annum per 1.5 acres on an average. This makes the crop popular and lucrative in the state when compared to others.

Pineapple is yet another popular perennial crop (biennial crop deemed to be perennial here as it doesn't fall under the regular season scale), especially in Ernakulam district and in central Kerala. Though the annual average income from the crop is similar those of others and below

those of popular perennial crop like rubber, this sector needs relatively less initial and total cost. Although the byproducts of the crop are officially not known (or reported), the crop residues are now popularly fed to livestock in the respective localities. Traditionally, farmers have not been considered pineapple leaves or residues as fodder and the case is still the same as we move towards northern Kerala (Malappuram for instance) as there is no commercial cultivation of exotic variety of pineapple. The local varieties of pineapple has hard to eat residue components (including their thorn leaves), but the new commercial varieties soft and having much to offer as green fodder. However, more attention is required in this regard in order to make it a scientific and popular alternative source of fodder.

Table 3.2: Cropping Pattern of Sample Households

Name of Crop	Total Area (Acre)	Average Area (Acre)	Production (Quintal/Acre)		Average Total Cost	Average Total Return
			Average Main Product	Average By-product		
Kharif/Rainy						
Paddy	34.07	1.06	41.81	3.45	57668.75	86610.94
Tapioca	5.42	0.54	5.6	0	28080	36170
Fodder	14.89	0.88	172.94	0	22811.76	0
Rabi/Winter						
Paddy	23.29	1.06	42.45	4.34	50772.73	72320.45
Tapioca	4.75	0.68	6.93	0	33542.86	43600
Fodder	14.89	0.88	172.94	0	22811.76	0
Summer						
NA	0	0	0	0	0	0
Perennials						
Coconut	5.38	0.67	343.75	0	51775	61125
Rubber	62.18	1.48	34.4	0.38	81335.71	133838.1
Nutmeg	1.6	0.53	7.07	0	216666.67	433333.33
Banana	21.12	0.96	633.18	0.14	49584.09	82936.36
Pineapple	2	2	400	0	32500	47800

Source: Primary Survey
NA = Not Available

Nutmeg is the highest income earning crop in the list that is about Rs. 200,000 per annum per 0.5 acre on an average. This is a spice crop and has regional preferences in growing and yielding. Thus it is not as popular as rubber across the state. However, nutmeg also has nothing to offer for feed and fodder sector per se. Coconut and banana are the two perennial crops (banana is

considered perennial here as it has no seasonal division to follow, although banana is annual crop) in the state which have something to give the fodder segment. On an average, coconut is cultivated in 0.7 acres and banana in 1 acre per person in the state. Both these crops encourage intercropping and mixed cropping (including fodders) and usually leave residues for livestock rearing. On the return part, coconut is not attractive as it fetches hardly Rs.10,000 per annum while banana fetches about Rs.33,000 per annum on an average. However, banana is extremely vulnerable to the monsoon related natural calamities in the state and often makes losses for farmers in pre-mature stage itself.

Paddy is the only crop that has been cultivated across all the three seasons in the state. On an average, paddy has been cultivated in about 1 acre in both kahrif and rabi seasons and it fetches about Rs. 25000 to Rs.30000 per season. The average land of paddy cultivation per person in the state is 1 acre, although it the major food grain in the state. This shrinking cultivation of rice in the state have now resulted in import of rice from other states such as Andhra Pradesh on a large scale. However, paddy continues to be the largest contributor to feed and fodder sector in terms of byproducts. On an average, 3.5 quintal per acre of byproducts has been generated through the sector during kharif season, mostly in terms of straw. Similarly, in rabi season, the byproducts of paddy is about 4.5 quintal per acre. The higher proportion of by product in Rabi season is backed by the relatively dry nature of the climate, whereas the kharif byproducts are highly vulnerable to monsoon. Tapioca on the other hand, has been cultivated in 0.6 acres on an average and fetches about Rs.8000 to 10000 in a year.

Fodder cultivation has higher land coverage than many of the crops in the list that is 0.9 acres on an average. This in turn relates to the fact that the fodder cultivation happens alongside main crops, mainly through fencing and uncultivated portions of the farm field. However, the cost profile of the fodder crop is as high as Rs. 23000 per annum. This might be the cost of initial investment such as preparing the field involving hired labor or machines, seedling or saplings and irrigation facilities (if required). However, there is no commercial selling of fodder crop in the state, which makes it zero earning crop. On the other hand, there are no local buyers either for fodder harvest, as far as the local farmers know. Hence, this sector needs a fundamental and structural change to change the fodder profile in the long run.

Table 3.3: District Wise Classification of Animals of the Sample Households

Sl. No	District	Buffalo (No.)		Crossbred Cattle (No.)		Indigenous Cattle (No.)		Goat (No.)	
		Male	Female	Male	Female	Male	Female	Male	Female
1	Kollam	18	15	35	247	4	5	59	113
2	Ernakulam	61	13	28	270	0	0	44	162
3	Malappuram	114	6	18	189	0	0	74	151

Source: Primary Survey

The district wise and gender wise pattern of animal rearing in the sample district of Kerala has been depicted Table 3.3. Among all categories of livestock, crossbred and female crossbred animals holds the larger share. Ernakulam districts tops in the number of crossbred cattle (270) followed by Kollam (247). The same pattern follows with male crossbred cattle as well; however the proportion of male cattle is roughly 10 percent of female crossbred cattle. On the other hand, Malappuram district tops in the number of buffalos (120) and that too male buffalos. Conversely to cattle profile, male buffalos are higher in number in all the sample districts. This indicate sthat the buffalo rearing in Kerala are targeting the meat market primarily, than the milk market. However, Ernakulam has only about one third of buffalos in Malappuram and Kollam accounts for one fourth of buffalos in Malappuram.

Malappuram districts tops in the number of goats (225) also, with about two third of them are female goats. Ernakulam accounts for around 200 goats and only one third of them are male. The higher share of buffalo and goat stock in Malappuram and Ernakulam district also indicates the popularity of meat markets in the regions while Kollam showcases its preference for milking practice over meat. In addition, all the 9 indigenous cows reported in the survey are also solely from Kollam district. Geographically saying, the southern Kerala (Kollam) concentrates on livestock rearing for milk and as we move towards central (Ernakulam) and north (Malappuram) Kerala, the focus of livestock rearing shifts from milk to meat.

3.4 Livestock Rearing Pattern

The Table 3.4 illustrates that the average value of the goat is increasing when the age of goat increases. There is a difference in the average value between the male goat and female goat such as the male goat has premium value when it is young and the female goat fetch a premium value as it grow older. The difference between the value of the male and female goats in the age group

of 1 to 2 years is around Rs. 1000 and the same difference is about Rs. 3500 in the category of above 2 years aged goats. The reason behind the pattern is logical that the male goat is primarily meant for the meat market where the younger meat (tender meat) is in high demand. On the other hand, female goats are primarily meant for breeding and milk for self consumption. However be the gender difference, the elder goats gets maximum value, as they will have maximum weight at that age per se.

Table 3.4: Average Value of Goat based on their Age (Rs)

Age Group	Goat	
	Male	Female
<1 year	7866.36	7871.03
1-2 Year	12080	11102.62
>2 Years	17900	14274.51

Source: Primary Survey

In the same way, the Table 3.5 depicts that a male buffalo has the highest average value of rupees one lakh on an approximation. This is primarily because the buffalos are meat market oriented and there is male preference for that matter. Similarly, an elder buffalo in the age group of one to two has about a lakh rupees value which may be again due to the high weight of elder animals. The milching and heifer buffalos values in the second and third positions respectively, which is more than half a lakh. Among cattle, crossbred are naturally high valued and milching has the highest average value which is approximately Rs.50,000. Even the heifer pregnant and cattle in the age group of 1 to 2 have a close average value to Rs.50,000. In indigenous cattle, a heifer pregnant values around Rs.35000 on an average.

Table 3.5: Average Value of the Buffalo, Cross Breed and Indigenous Cattle (Rs)

Particulars	Buffalo	Crossbred Cattle	Indigenous cattle
Milching	77500	53963.46	47000
Dry	11928.57	21416.67	3625
Male	101665.80	11244.33	3625
Heifer Pregnant	60000	49011.11	35000
Heifer non-pregnant	0	41000	0
<1 year	53180.56	12296.86	3625
1-2 Year	103850.39	50061.70	0

Source: Primary Survey

On the whole, less than one year age and male crossbred cattle has the lowest value in the category, while dry category in buffalo and dry and male categories in indigenous cattle has the similar lowest average values in their respective categories. Generally, the animal value is determined by the milching or about milch chances in cattle and the values is determined by the weight in buffalos. So milk and meat are the crucial factors in determining the value for livestock in the state, subject to the nature of livestock. Say for instance, milching in cattle is attractive and meat or body weight in buffalo is crucial in valuing.

3.5 Details of Fodder and Feed Fed to Livestock

There are different feed and fodder intake (per day) for milching, dry, male, heifer pregnant, heifer non-pregnant, young stocks, and adult livestock. Also, the fodder are varying in nature such as green fodder, dry fodder, concentrates, supplements and grazing fodder. The ratio of these fodders will considerably vary with differing nature of livestock. Further, the choice of a particular fodder or combinations of fodders have cost considerations and availability considerations. The Table 3.6 depicts the average feed and fodder requirements per day for a buffalo in the state. A milching buffalo is consuming around 42 kg of green fodder with zero cost and five kg of dry fodder which costs Rs. 20 per quintal. The total quantity of concentrates and supplements required in a day for a buffalo is around 5 Kg and it costs around Rs. 63 per quintal. Milching buffalo needs more than three hours of grazing per day on average.

In the case of dry buffalo, there is a total requirement of 25 Kg of fodder including both green and dry. Since the green fodder is free of cost, there is a Rs. 20 per quintal cost involved for farmer on account of dry fodder alone. The required amount of concentrates and supplements needed for a dry buffalo is 2 kg which costs around Rs.57 per quintal. A dry buffalo does not require a grazing every day. At the same time, male buffalo needs around 30 Kg of green fodder and dry fodder together, of which dry fodder costs Rs. 20 per quintal and a total of 2 Kg of concentrates and supplements which may cost around Rs. 65 per quintal. Male buffalos require more grazing time compared to others, which is around 4 hours per day. A heifer pregnant buffalo needs almost a similar quantity of food requirement as a milching needed. However, it required less grazing time than the milching cow. Compare to other buffalos, young stocks (less than one year old.) and adult buffalos (1 to 2 ages) do not require much fodder. At the same

time, both of these categories requires more time for grazing, which is 5 hours and 4 hours respectively.

Table 3.6: Average Feed and Fodder Requirement for Buffalo (per day per animal)

Particulars	Green Fodder		Dry Fodder		Concentrates		Supplements		Grazing (hrs/day)
Quantity / Price / Hours	Qty (Kg)	Price (Rs / Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	
Milching	41.364	0	5.190	19.52	3.381	28.28	1.137	35.33	3.27
Dry	22.857	0	1.786	20	1.5	25	1	32	0
Male	26.612	0	3.974	19.31	1.741	27.49	0.351	37.34	3.62
Heifer Pregnant	41.875	0	4.125	18.12	3.5	27.25	1.5	32	3.125
Heifer non-pregnant	0	0	0	0	0	0	0	0	0
<1 year	20.333	0	2.062	18.92	1.097	32	0.052	24.85	4.11
1-2 Year	28.705	0	4.466	18.75	1.926	28.21	0.310	42.21	3.46

Source: Primary Survey

The approximate amount required for the fodder, supplements and concentrates for the buffalo rearing in Kerala is Rs.90 per day (for buffalo aged between1-2 year), which is the highest among categories of the buffalos. At the same time, the fodder cost for the young stocks in the state is Rs.76 per day, which is the lowest among others. It indicates that the costs of fodder for various segments of buffalos are not varying much, attributing to the homestead style of animal husbandry in the state. The green fodder in state is free of cost for all, as these are primarily been collected from nearby places (which is possible for micro homestead units of animal rearing) and the dry and concentrate components of fodder costs vary subject to age and sex of the stock. On an average, milch and pregnant stock go hand in hand in their requirements of fodder (and thereby the cost also) where as male and dry buffalos can be equated for the same purpose.

The daily basis feed and fodder requirements of cross breed cattle in the state have been depicted in the Table 3.7. Milching cattle require 34 kg of green fodder and dry fodder together and it needs around 4 Kg of concentrates and supplements together. The average cost of fodder for cattle is similar to those of buffalos, their ups and downs mainly depends on the quantity variations alone. Milching cattle require about 3 hours of grazing per day, while dry cattle

requires only about half the time of milching cattle. The average fodder requirement of the dry cattle is also about half of milching cattle. Expectedly, the total cost of the feeding is minimal for dry cattle among others, which is Rs. 88 per day. The feeding cost of a milching cattle it Rs. 94 per day on an average, which indicates that there is no huge gap between the cost involved between milching and dry cattle.

Table 3.7: Average Feed and Fodder Requirement for Cross Breed Cattle (per day per animal)

Particulars	Green Fodder		Dry Fodder		Concentrates		Supplements		Grazing (hrs/day)
Quantity / Price / Hours	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	
Milching	29.24	0.01	3.99	22.04	3.27	31.17	0.80	40.04	2.18
Dry	13.57	0	2.18	19.48	1.65	25.84	0.34	42.38	1.21
Male	16.65	0	1.78	23.20	1.10	28.8	0.37	43.05	1.05
Heifer Pregnant	27.75	0.04	3.24	21.86	2.27	27.67	0.69	39.05	2.17
Heifer non-pregnant	36	0	3.3	36	4	25	0.1	45	4.4
<1 year	13.87	0	1.03	23.04	1.05	28.86	0.29	44.41	1.73
1-2 Year	28.61	0	1.66	23.28	1.28	28.95	0.26	47.14	2.49

Source: Primary Survey

Male cattle require 19 kg of green and dry fodder together per day and it needs comparatively less amount of concentrates and supplements (2 kg per day). Similarly, male cattle grazing hour is just 1 hour per day which is the lowest among others. This indicates that the male cattle rearing are not popular among farmers and they are usually not cared by the farmers as they do for milching and heifers. With the increased popularity of the artificial insemination for breeding, male cattle are not considered to be worth for rearing. Also, buffalo meat is preferred in Kerala over cattle meat in the meat market. Therefore, reportedly, this segment of cattle is comparatively less fed, including grazing and green fodders which are actually of no cost.

The young cattle are those which can grow to heifers which is a popular category of cattle among farmers. The required amount of fodder and concentrates and supplements for the young cattle are 17 kg and 1.5 kg which is naturally the lowest fodder requirement among others. However, the cattle of 1 to 2 years age require 31 kg of green and dry fodder together which is almost the

same as heifer pregnant cattle. On the other hand, the concentrates and supplements required for this category are similar as male cattle. This indicate that only the very young stock has minimal in take per day and as they grow to heifers or matured male cattle, they are converging to the intake requirements of adult cattle.

As already mentioned, heifer is the next generation milching cattle for farmers and therefore they are being nurtured well by the farmers, in terms of feeding. Heifer pregnant cattle require 31 kg of green and dry fodder together and 3 kg of concentrates and supplements together. These amounts of all forms of feed are nearing the requirement of milching cattle and heifers also needs almost similar grazing hours of them. Even though the required fodder for the heifer pregnant is almost similar to milching cattle, the cost of the fodder is slightly low as compared to milching cattle. The heifer non-pregnant reports the highest requirement for feeding per day (44 kg), as well as the total cost of feeding per day (Rs. 106). It implies that the farmers are keen in getting them pregnant or milching sooner by the added efforts in feeding. Usually, non-pregnancy of heifers are observed as the insufficiency of feeding by the farmers and they start supplementing the feed per day. The average grazing hours for the non-pregnant heifer is also the longest as compared to others, which are more than 4 hours.

Table 3.8: Average Feed and Fodder Requirement for Indigenous Cattle (per day per animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements		Grazing (hrs/day)
Quantity / Price / Hours	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	
Milching	8	0	0	0	0	0	0	0	4
Dry	1.5	0	0	0	0	0	0	0	0
Male	1.5	0	0	0	0	0	0	0	0
Heifer Pregnant	2	0	0	0	0	0	0	0	0
Heifer non-pregnant	0	0	0	0	0	0	0	0	0
<1 year	1.5	0	0	0	0	0	0	0	0
1-2 Year	0	0	0	0	0	0	0	0	0

Source: Primary Survey

Indigenous cattle are rare to find in the state and hence their rearing as well. Table 3.8 depicts a clear picture of the scenario as all categories of indigenous cattle are being fed only by green

fodder which costs zero in monetary terms. Milching indigenous cattle require only about 8 kg of green fodder and 4 hours of grazing a day. This is way too less when we compare the feed intake and cost involved with cross breed cattle rearing. Dry indigenous cattle, young indigenous stocks and indigenous male cattle are not put on grazing either and perhaps they need less than 2 kg of green fodder per day. Only the heifer pregnant indigenous cattle require about 2 kg of green fodder a day. The reportedly less number of indigenous cattle has a stake on the values shown in the table, as they are replica of a very few respondents. However, in general it implies that the cost of indigenous cattle rearing is very less in the state. However, since their milk production is also proportionally less when compared to cross breed cattle, it is not viable to rear indigenous cattle in the state where already space and inputs are a growing concern. Apparently, this may be the reason behind the least reporting of indigenous cattle rearing in the survey.

Table 3.9: Average feed and Fodder Requirement for Goats (per day per animal)

Particulars	Gender	Green Fodder		Dry Fodder		Concentrates		Supplements		Grazing (hrs/day)
		Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	Qty (Kg)	Price (Rs/ Qtl)	
<1 year	Male	3.32	0	1	17.5	0.61	20.73	1.34	32.67	3.48
	Female	4.82	0	2.33	5	0.58	19	0.81	15.78	3.27
1-2 Year	Male	4.85	0	1.5	15	0.60	17.33	0.78	31.36	3.32
	Female	4.48	0	1.44	16.11	0.60	18.22	1.00	30.52	3.40
> 2 Years	Male	5.5	0	0	0	0.8	18.6	0.14	55	4.2
	Female	5.5	0	0	0	0.74	20.48	0.12	54.28	3.39

Source: Primary Survey

Goats are the second popular animal in homestead rearing in Kerala (excepting poultry sector), and Table 3.9 depicts the age wise and sex wise fodder requirements for them. It is evident that the fodder requirement for male goat and female goat are different. The male goats which are under the one year of age require less fodder than the female goat of the same category. However in the case of concentrates and supplements male goat needs more than female goats. Both male and female goats require an average 3 hours of grazing a day. On the cost comparison, a male goat costs around Rs.70 per day as against Rs. 40 for a female goat. This may be attributed to the fact that the male goat (especially at the younger age) has high demand in the meat market, so as the farmers want them to gain maximum weight by then. In the meanwhile, female young goats

are meant to be rearing and breeding in the long run, so as they do not require a quick growth through feeding. As usual, green fodder costs nothing in goat rearing as well in the state dry fodder is least preferred for feeding goats.

In the age group of 1 to 2 years old goats, we can see a reverse pattern as compared to the previous category. Here, both the male and female goats requires almost same amount of all feed and fodder per day. Therefore, the costs involved in rearing this category goat are same as Rs. 60 on an average. Similarly, grazing hours are the same average 3 hours a day. Somehow the the same pattern is visible in the feed and fodder requirement in the case of the goats aged more than 2 years also. The only significant difference here is the male goats requires 4 hours of grazing per day. It is evident that the female goat which belongs to the age group of less than 1 year requires the highest amount of total feed and fodder whereas the same category of male goats requires the lowest quantity of feed and fodder per day. However, their composition varies and the cost is high for male goat in the category, as already explained. Totally, it implies that the age and gender specificity of goat is not a big deal in determining the feed and fodder requirement in the state. Since male goats are meant for meat market, they get a higher consideration in terms of feed and fodder at the young age, however, that pattern is not sustaining as they grow to age beyond one.

The Table 3.10 indicates the details of the total feed and fodder requirement in the state as per the National Agricultural Technology Project (NATP) Standards in the state. This calculation has been made on the basis of recent livestock population in the state (2019)[4]. As per the estimation, the milking cattle require total 11 Kg of green fodder and dry fodder together besides about 1 Kg of concentrates per day. This standard estimation is however well below the actual feed and fodder being fed to the cattle as per primary survey. Among the cattle, more than fifty thousand are milking and they require a total of 6,12,4536 kg feed and fodder together.

There are also more than 1 lakh dry cattle in the state, which requires 8, 33,370 kg of feed and fodder. There is another 1 lakh plus young cattle in the state and they demand only about half of the feed and fodder requirements of dry cattle of the same volume. The number of adult male cattle in the state is less than twelve thousand with a requirement of 1, 20,893 kg of feed and

[4] A detailed version of the methodology of this table is (as given by the ISEC Bangalore) appended to this study (see appendix 3.1)

fodder. Dry fodder demand is high when compared to green fodder across all categories of cattle except young stock. For young stock, both green and dry fodder demand comes almost equal. Expectedly, higher requirement for concentrate feeds are accounted by in-milk cattle followed by dry cattle and adult male cattle. However, the farmers reports about 3 to 5 times higher feeding of green fodder and concentrate in most of the incidences under the primary survey. Only the dry fodder estimation remains relatable to the primary survey to some extent. May be this is the minimal requirements and the farmers are making it well beyond the point.

Table 3.10: Total Feed and Fodder Requirement as per the NATP Standards in Kerala

Animal category	Number of Animals*	Green Fodder		Dry Fodder		Concentrates	
		(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)
Cattle	1342000						
In-milk	562400	4.75	2671400	5.50	3093200	0.64	359936
Dry	106569	3.40	362334.6	4.02	428407.38	0.40	42627.6
Adult Male	11602	4.06	47104.12	6.03	69960.06	0.33	3828.66
Young Stock	111616	2.18	243322.88	2.13	237742.08	0.18	20090.88
Buffalo	101000						
In-milk	5234	5.96	31194.64	6.34	33183.56	1.05	5495.7
Dry	1449	5.44	7882.56	4.95	7172.55	0.52	753.48
Adult Male	6434	4.04	25993.36	7.47	48061.98	0.36	2316.24
Young Stock	77459	2.29	177381.11	2.22	171958.98	0.19	14717.21
Goat	1359161	1.04	1413527.44	0.20	271832.20	0.06	81549.66
Sheep	1979	1.01	1998.79	0.20	395.80	0.04	79.16

*Note 1: *Author Compiled from 20th Livestock Census*
Note 2: Feed and Fodder details (Kg per animal) is as given by NATP Standards
Source: Author Calculations

In general, feed and fodder requirement of buffalos are higher when compared to cattle. This can as well be attributed to Kerala's least preference to buffalo rearing, within the given scarcity of feed and fodder. Among the buffalos, the in-milk category needs a total of 12 Kg of fodder and 1 kg of concentrates. Notably, the adult male buffalo requires maximum dry fodder that is about 8 kg and in all other instances, in-milk buffalo accounts for higher requirements of feed and fodder followed by dry, adult male and young stock buffalos. Again, these estimation fall behind the actual reported by the farmers in primary survey. However, the higher proportion of young

buffalo stock in the state is an indication of increasing popularity of buffalo rearing, especially for the requirements of meat market. Goat rearing sector estimation of feed and fodder is the most proximate one to those reported in primary survey by the farmers.

Table 3.11: Green Fodder Yields for Land Use Classification in Kerala

Sl. No	Land Use Category#	Green Fodder (tons/ha/year) #	Total Area (Ha)*	Total Availability (Tons/Ha)
1	A)Area under fodder crop	40.93	2750	112557.50
2	B)Forest area and on assumption that only 50% area was accessible for grazing	3.00 (1.50 if considered whole forest area)	1081509 (whole forest area)	3244527.00
3	C)Permanent pastures and other grazing lands	5.00	0	0.00
4	D)Cultivable wastelands	1.00	96496.73	96496.73
5	E)Current fallows	1.00	57463.59	57463.59
6	F)Other fallows	1.00	45540.92	45540.92
	G) Barren and uncultivated land*	1.00	10280.57	10280.57
7	H) Misc. Tree Crops and Groves not Included in Net Area Sown	1.00	2117.88	2117.88

Note 1: # As given by FAO (2012), Ramachandra et al (2007)
*Note 2: * As given by Kerala Economic Review (2019)*
Source: Author Calculations

Estimation of green fodder availability in the state using the standard methods (see appendix 3.1) is demonstrated in the Table 3.11. As per the estimation, there is an estimated 1,12,000 hectares of fodder crop area in the state, which translate in to 2,78,000 acres. Additionally, there is about 32.5 lakh hectares of forest area assumed to feed the livestock sector. There is about a lakh hectare of cultivable waste land, fallow land and barren land in the state to cater the needs of livestock sector. However, there are no permanent pastures and other grazing lands in the state, as available in other states of India. Miscellaneous tree crops and groves which are used as fodders are also relatively less in the state.

Table 3.12: Estimation of Harvest Indices and Extraction Rates of Feed from Crop Production in Kerala

Sl. No	Crop	Number of Acres in the State (Ha) #	Harvest Indices (HI)*				Extraction Rate (ER)*			
			Crop residues*	Total (Kg)	Oil Cakes*	Total (Kg)	Grains*	Total (Kg)	Brans and Chunnies*	Total (Kg)
1	Paddy	198026	1.30	257433.80	NA	NA	0.02	3960.52	0.08	15842.08
2	Wheat	0	1.00	0	NA	NA	0.02	0	0.08	0
3	Sorghum	0	2.50	0	NA	NA	0.05	0	NA	NA
4	Bajra / Pearl Millet	0	2.50	0	NA	NA	0.05	0	NA	NA
5	Barley	0	1.30	0	NA	NA	0.10	0	NA	NA
6	Maize	0	2.50	0	NA	NA	0.10	0	NA	NA
7	Ragi	0	2.00	0	NA	NA	0.05	0	NA	NA
8	Small Millets	0	2.50	0	NA	NA	0.10	0	NA	NA
9	Other cereals	0	2.00	0	NA	NA	0.10	0	NA	NA
10	Pulses	956.65	1.70	1626.31	NA	NA	NA	NA	0.03	28.70
11	Ground Nut	0	2.00	0	0.70	0	NA	NA	NA	NA
12	Oilseeds (Coconut)	760946.6	NA	NA	0.70	532662.62	NA	NA	NA	NA
13	Sugarcane	993.27	0.25	248.32	NA	NA	NA	NA	NA	NA

*Note 1: * As given by ISEC Bangalore, FAO (2012), Ramachandra et al (2007)*
Note 2: # As given by Kerala Economic Review (2019)
Note 3: NA = Not Applicable
Source: Author Calculations

In continuation, the Table 3.12 gives estimates of factors in terms of Harvest Indices (HI) and Extraction Rates (ER) of feed resources such as crop residues, oil cakes, grains, brans and chunnies of various crops from crop production in the state. A detailing of these estimations can also be found in Appendix 3.1 to this study. It is evident that Kerala has not been producing nine out of 13 crops listed, which have potential to contribute substantial residue as feed. This scenario is the prime reason for Kerala's dependency on other states like Tamil Nadu even for inputs for in-state fodder production units. Kerala reports with nil production of almost all forms

of millets which are otherwise major contributor to feed and fodder sector. There are cultural and geographical reasons behind this situation and that cannot be changed for now. Only two crops namely paddy and coconut has substantiate share of producing residue for feed and there is a small share of pulses and sugarcane in the list.

It is estimated that the paddy sector in the state produce about 2.5 lakh kg of crop residue and 16000 kg of bran as feed for the livestock sector in the state. Similarly, coconut field contribute about 5.5 lakh kg of oilcake to the feed sector, on an approximate estimation. Pulses production in the state contributes a 2000 kg of crops residues and only about 28 kg of brans and chunnies to the feed matter. The paddy sector also results in having about 4000 kg of grains also to the feed sector, while the contribution of sugarcane in this regard is limited to few hundred kg of crop residues. On the whole, paddy remains the major source of feed input in the state, in varied forms, followed by coconut. Both these crops are traditional crops of Kerala's agricultural profile.

Table 3.13: Difference between Total Feed and Fodder Available and Required in Kerala

Green fodder (Tons)			Dry fodder (Tons)			Concentrates (Tons)		
Required (R)	Available (A)	Difference (R-A)	Required (R)	Available (A)	Difference (R-A)	Required (R)	Available (A)	Difference (R-A)
4982.14	3568984.19	-3564002.05	4361.91	791.97	3569.94	531.39	19.83	511.56

Source: Author Calculations from Tables 3.10, 3.11 and 3.12

In summation, Table 3.13 depicts the total availability of and requirement for feed and fodder for the livestock sector in the state. This is a consolidation of the information illustrated through Tables 3.10, 3.11 and 3.12 which are estimated based on secondary data gathered through various government sources. It is evident that the green fodder availability in the state is way high than the requirements of the live stock sector. Though the green fodder cultivation is very abysmal in the state, the greenery otherwise in the state is the large contributory to this surplus availability of the green fodder. On an average, there is an availability of 36 lakh tons of green fodder as against the demand of mere 5000 tons. This may be one of the prominent reason for the

least preference for fodder cultivation (which often involve costs in terms of land, money and man) in the state, however subsidized they are.

However, the surplus profile is limited to the green fodder. Both in the case of dry fodder and concentrates, the case are way different from green fodder. There is severe deficit in their availability in the state. In the case of dry fodder, there is a deficit of 3600 tons on an average which is five times higher than the availability of dry fodder in the state. In the same way, there is huge deficit of 512 tons concentrates against its meagre availability of 20 tons in the state. In other words, the deficit of concentrates in the state is about 25 times higher than that of the availability. Together, this situation points to the extreme dependency of the state on other states for feed and fodder to cater the needs of the livestock sector.

The principal reason behind the huge gap between the demand and supply of feed and fodder in the state (excluding green fodder) is backed by the poor crop residue profile of the state. As depicted in the Table 3.12, most of the potential crops with regard to crop residue are not being cultivated in Kerala on account of geographical and agricultural reasons. The few potential crops being cultivated in the state such as paddy and coconut are going on shrinking their share in the agricultural profile of the state. On the other hand, the expanding cash crops in the state have nothing to offer to the feed and fodder sector in general. This poses a serious threat for the livestock sector in the state in the long run. At the same time, there are some untapped potential areas in the state such as pineapple residues for instance.

Table 3.14: Major Sources of Livestock Feeding

Sl. No.	Source of Livestock Feed	Number of Households Reported	Percentage
1	Grazing land	197	90.78
2	Crop residues	100	46.08
3	Improved forage and pasture	55	25.34
4	Household left over	170	78.34
5	Tree legumes grown as hedge or anything similar	59	27.19
6	Feed preservation and storage	18	8.29

Source: Primary Survey

The question major sources of livestock feeding in the state has been understood as what are the major sources of feeding the livestock, in addition to feeds (concentrates). This is because feeding concentrate is a routine of livestock rearing in Kerala, unlike many other states in India.

This is more visible in cattle rearing segment, as that is the milking sector among the three. However, buffalo and goat rearing also involves at least a minimal intake of concentrate feed as a routine. Therefore the most less number of reporting for 'feed preservation and storage' depicted in Table 3.14 need to be viewed from this angle. The table also reports that most of the farmers (all type of animal rearing taken together) reported with grazing land as the major source of livestock feeding, is true partially only. Grazing in the state is always an addition to the routine feed for animals in Kerala.

Notably, household leftover or residues, that are the food wastes produced in a household, serve the purpose of animal feed in the state. This is a true and peculiar feature of homestead based animal husbandry in the state. In the rural areas, even food wastes from neighbourhoods and catering units (such as restaurants, educational institutions, etc) are being collected for the purpose of feeding cattle. Giving porridge water as an alternate for regular water is also an associated practice of feeding in Kerala. Crop residues come in the next line of feeding sources, which is typically the paddy residue in the state. As vegetable and other cereals cultivation is minimal in Kerala, paddy remains the most residues creating sector for feeding purpose. Only about 60 farmers reported usage of forage and tree legumes as the source of feeding, marking it in the last row of preferences.

3.6 Sheds and Fodder Storages Scenario

The state of Kerala is known for its 'consumption status' and construction field related to habitat culture. Naturally, the reflections of the preferences of habitat construction sector are visible in cattle shelters as well. As the Table 3.15 depicts, lion share of cattle and goat sheds in the state fall under pucca category. They have pucca structure and features, using almost the similar materials being used for habitat construction in the state. However, these shelters have deteriorated over time and patched up later with available other materials. A series of photo evidences on cattle and goat shelters are appended to this report (see appendix X.1).

On the other hand, kachcha and mixed shelters for animals are rare to find in the state. There are only 24 such shelters reported altogether for both cattle and goat. Apart from the general construction style influence in the state, there is a non-availability of kachcha materials in the state or such materials are costly due to scarcity. Given the six month long rainy season of the

state make kachcha constructions extremely vulnerable to deterioration in a year itself. Therefore, if farmers choose to make kachcha shelters, they are indirectly committing a recurring maintenance cost thereafter. Therefore, farmers are generally evading kachcha constructions, though they are statistically deemed as less costly.

Table 3.15: Details about Cattle Shed

Particulars	Pucca		Kachcha		Mixed	
	Number	Average Value (Rs)	Number	Average Value (Rs)	Number	Average Value (Rs)
Cattle Shed	189	107910.64	2	15000	11	30454.54
Goat Shed	133	37437.59	10	13700	1	20000

Source: Primary Survey

On an average, a pucca cattle shed construction in the state costs around one lakh plus rupees. This high cost indicates the influence of materials used for regular habitat construction being used in the sector as well, and the high labor cost in the state. At the same time, a mixed shelter construction in the state costs around Rs. 30,000 on average, which is one third of pucca construction and double of kachcha one. Similarly a pucca goat shed costs around Rs. 40,000 on average and a mixed one costs around Rs.20,000 that's half of the pucca construction and about double of kachcha construction. In short, cattle shed construction in the state requires a huge money investment for farmers in the very beginning of animal rearing.

3.7 Labor and Maintenance

Labor cost in Kerala is the highest in the country for varied reasons and that is one of the biggest concerns of agricultural sector too. May be attributing to this, the Table 3.16 depicts very less labor involvement in the animal husbandry sector of the state. On an average, there is only about 2 labor hour's requirement in buffalo and cattle rearing in the state. Out of this, female labor involvement is limited to cattle rearing alone. As the meat market targeted buffalo rearing in the state requires more and continuous male labor, its costs around Rs. 18,000 per annum. At the same time, cattle rearing hardly need Rs. 1000 per annum of which female wage rate is marginally high. It implies that the cattle rearing labor involvement will be something like piece rate working for green fodder collection or milk distribution locally, than a full-fledged labor involvement in buffalo sector.

Table 3.16: Details of Labor and Other Maintenance Charges

Particulars		Buffalo	Indigenous Cattle	Crossbred Cattle	Goat
Labor requirement	Male (Hrs)	2	0	1.08	0
	Female (Hrs)	0	0	1	0
Labor cost* (Rs/ year)	Male (Rs)	182500	0	512.5	0
	Female (Rs)	0	0	533.33	0
Veterinary cost (Rs/annum.)		1675	1000	2586.49	667.13
Maintenance cost		798.33	0	574.30	571.05
Equipments, electricity and water charges. (Rs./annum)		395.56	0	2098.78	323.53
Any other cost (Rs)		415.52	0	559.09	393.75

*Note 1: *Convert 8 hours per day for a wage rate*
Source: Primary Survey

Expectedly, the highest average veterinary cost is reported with crossbred cattle rearing followed by buffalo and indigenous cattle. Goat rearing has the lowest average veterinary cost that is Rs. 667 per year. However, annual average maintenance cost involved in goat and crossbred rearing is almost same while there is a higher cost for buffalo rearing in this regard. Just as in case of veterinary cost, crossbred cattle accounts for the highest cost for equipments, electricity and water charges and the cost for goat and buffalo rearing is approximately one sixth of those of crossbred cattle's. Miscellaneous costs are almost similar for all types animal rearing in the state.

Overall, indigenous cattle rearing has only veterinary charge involved and goat rearing has no cost on account of labor charges. On the whole, the labor and maintenance charges in buffalo sector per annum is more than Rs.20,000 per year while the same cost is less than Rs.10,000 per year for cattle rearing. The goat rearing sector at the same time requires an average of Rs.2000 per year as labor and maintenance charges. The lower costs of cattle and goat rearing implies that there is homestead (backyard) rearing and most of the labor is being borne by the household members for no charge. This is usually due to the women's and children's involvement in managing the homestead livestock.

3.8 Returns from Livestock

The return from an investment is matter the most in determining the future of a particular sector. The average annual return from animal rearing is estimated and drawn in the Table 3.17. The cattle rearing being milk oriented depicts a situation where income is generated only from milk and dung, while buffalo and goat rearing has additional earnings from meat market. Although the animal sale is happening in cattle sector as well, they are mostly as substitute for a milch cow, not exactly a sale for meat market. Hence farmers did not report those sales under earning for meat. A crossbred cattle rearing farmer has a yield of 9.5 thousand liters of milk per year, accruing an estimated average annual income of Rs. 43000. This in turn translates to an earning of Rs.46 per liter of milk that is a good price. However there are regional variations in milk price and the average does not hold true across state. The farmers are generally of the opinion that their milk is underpriced and there is an urgent need to increase the price for managing the ever increasing cost of feeds. Besides, this sector fetches him another average income of Rs. 22000 through dung sale.

Table 3.17: Returns from Livestock Rearing (Annual Average)

Particulars		Crossbred Cattle	Indigenous Cattle	Buffalo	Goat
Milk*	Yield in liters	9226.86	4380	3072.5	2486.77
	Sales price (Rs.)	426237.11	210240	155300	99470.8
Milk (Daily)	Yield in liters	25.28	12	8.42	6.81
	Sales price (Rs.)	1167.77	576	425.48	272.52
Dung	Tons	2.34	0	2.69	4.14
	Sales price (Rs.)	21750.30	0	11226.39	17200
Sales details of animal	Animal weight (Kg)	0	0	156.61	23.35
	Sales price (Rs.)	0	0	53055.36	15432.55
Any other by-product	Kg/animal	0	0	0	0
	Sales price (Rs.)	0	0	0	0

*Note 1: * Milk production per day is converted according to average lactation period per year*
Source: Primary Survey

The indigenous cattle rearing have only one source of income generation that is milk. On an average, this sector fetches about 4400 liters milk an years with an average earning of Rs. 21000. When compared to crossbred cattle, this almost half of their yield and earning that the indigenous cattle offers for the farmers. This is why the farmers are not fond of rearing indigenous cattle in

the state. Due to the number of indigenous cattle rearing farmers are less, and the number of cattle per farmer is also minimum, there is no dung or meat income associated with sector.

Buffalo rearing in the state seems rather profitable, though that is not popular in the animal husbandry scenario of the state. A buffalo rearing farmer fetches about 3000 liters of milk per year on average, which gives him or her about an annual average earning of Rs. 155000. This is roughly one third of the milk production of the crossbred cattle and three times higher income of their earning. This in turn translate to an earning of Rs. 51 per liter of milk, way higher than cattle milk which is backed by the rich fat content in it. Framers also endorse this fact and continue to hesitate to step in for buffalo rearing at the same time. Buffalo rearing also get the farmer an additional earning of Rs. 12000 through dung and Rs. 53000 through meat sale on an average per annum.

Goat rearing sector also depicts a good picture of earning for farmers in the state. From 2500 liters of annual average milk production, the sector earns about Rs.100000 on average per year. That in turn translates to a price Rs.40 per liter of milk being produced. In the local market, goat milk has high demand high price than this projected average price. Goat rearing also get the farmer an additional earning of Rs. 17000 through dung and Rs. 16000 through meat sale on average per annum. Together, goat rearing sector profile is also lucrative for farmers in the state per se.

Chapter IV - Constraints, Views and Suggestions

4.1 Introduction

The animal husbandry sector in Kerala is certainly peculiar from the rest of the country by its nature and composition. Hence, any policies under a larger national umbrella might not suit the state and the stakeholders involved in the process have to understand the boundaries of the sector within the state specific context. Apart from the statistics and technical jargon for that matter, it is also important to understand the concerns from farmer's point of view. Sometimes the best suggestion to improve the sector cannot be drawn by the mathematical derivations while an experienced hand can give it verbally. Therefore, this chapter compiles and presents the perceptions of animal rearing farmers with regard to probable challenges and possibilities.

4.2 Constraints and Perceptions

As already pointed out, land shortage is the major constraint; but there are also social constraints too. Widespread success of family planning and consecutive nuclear family system irrespective of rural-urban disparity has resulted in mushrooming constructions in the state, which accelerated bifurcation of agricultural land and possessions and making it in to habitats. In the urban and semi-urban spheres, it further forced the farmers to leave their plots since a partial construction in the field affect the other areas of the same field in terms of unease use of machines and equipments, floods, increased cost of maintaining small plots. However, these are unavoidable developmental changes fuelled by the foreign remittances and high achievements in education sector when compared to other states of India. The only thing is that the already thin geography has worsened the condition quickly for agricultural sector.

Naturally, the most reported constraint in adopting fodder cultivation by farmers in the state is land scarcity. Table 4.1 depicts that about one third of the respondents have made it a point when dealing with fodder cultivation. The existing minuscule fodder cultivation is either accounted by the few large farmers (farms with hundreds of cattle) or by the mixed and intercropping of the marginal farmers. The term mixed or intercropping here mean to say that there is few fodder stumps in the homestead such as a small fencing to regular field, small piece of forage field during off season, backyard garden of forage. This is there just because the famers are been compelled by the Agricultural Offices (such as Krishi Bhavans) or motivated by subsidies for

that matter. Otherwise, there is a clear lack of interest by the farmers in fodder cultivation due to land constraints.

Table 4.1: Constraints faced by the Sample Households for Fodder Cultivation

Sl. No.	Constraints	Number of Households Reported	Percentage
1	Land is very less therefore cannot afford to put more land under fodder seed/crop production	145	66.82
2	Non availability of adequate irrigation water	76	35.02
3	Non Availability of labor	44	20.28
4	Land is not suitable for fodder production	63	29.03
5	High cost of cultivation/Production and low return on fodder production	81	37.33
6	Low price prevails for green fodder in market	92	42.40
7	High cost of fodder seed	78	35.94
8	No provision of quality seed by society on credit and Non availability of quality fodder seed in market	34	15.67
9	Availability of grazing lands	105	48.39
10	Lack of training facilities	100	46.08
11	Poor Livestock extension services	71	32.72
12	Lack of awareness about government programs on subsidy on seeds	81	37.33
13	More Laborious	81	37.33
14	Lack of awareness on production and post-harvest techniques	63	29.03

Source: Primary Survey

Availability of grazing land, mostly in terms of neighborhood (unclaimed or open) is the second popular reason for not doing fodder cultivation. With the given six month long monsoon and relatively very narrow summer, the state still has good greenery in almost all geographical dimensions of the state. With the homestead style of animal rearing, this greenery is sufficient to meet the green fodder requirements of the animal rearing sector in the state. Further, the rural farmers usually prefer local greenery fodders than the cultivated varieties of green fodder. It is because that the natural greenery gives a variety of green leaves or grass while the cultivable greenery is just one uniform green grass. Though there is no scientific basis for such belief, farmers confined to have such a belief, on the basis of their experience.

Although these two major reasons are the prime causes of not doing fodder cultivation in the state, they are exogenous in nature also. They both are not confining to the man made framework of agricultural routine and being externally determined. The most reported endogenous constraint

in fodder cultivation is lack of training facilities in this regard. Farmers observe that the fodder seeds or stumps are being distributed at times (especially when there is a subsidy scheme) and they are asked to do fodder cultivation from that point of time. There are no sufficient training and extension activities in this regard, such as how to maintain, how to harvest, how the post harvest management to be done, etc. For farmers, they are treating it just as another grass which naturally grow in their field and often find it is not growing as expected. Eventually, they are off from the hassle of making green fodder when alternates are available.

A connected issue with fodder cultivation and lack of training is of course lack of awareness about the practice and its dimensions. Practically, the farmers are yet to consider fodder as non-food crop (such as rubber for instance) and therefore do not know the prospects of making it a farming item. All they know is that it is laborious work if doing on their own, it is costly when involved with agricultural labors (agricultural labor cost in Kerala is the highest in the country), and there is very less price prevails in the market for fodder harvest. Hence, it is important for the concerned authority to let farmers aware that fodder is as similar as any other crops being cultivated in the state, it has good demand and there is room for profitable farming of fodder if practiced regularly. Alongside, extension services such as mechanized harvesting, processing and stocking should also be made familiar for the farmers.

Table 4.2: Total Number of Farmers Adopted Post Harvest Techniques

Adopted Post Harvest Techniques	Yes (%)	No (%)
Number of Households	0	100

Source: Primary Survey

A related picture is depicted in Table 4.2 which records that there are no farmers doing post harvest techniques with fodder cultivation in the state. No wonder, there is no room for doing post harvest techniques in this regard with the minuscule fodder cultivation land and practice in the state. Also, when the farmers feel the fresh fodder cultivation itself is laborious and expensive and non-profitable, post harvesting scenario has to go long ways to realize in the state. In fact, even the well modernized farmers are not very familiar or interested with the post harvest of fodder crops. One of such case is depicted through Figures 4.1, 4.2 and 4.3. The former two demonstrate that how the excess fodder in the farms are being managed.

Figure 4.1 and 4.2: Excess Green Fodder being Kept Idle in Farm in Malappuram, Kerala

Source: AERC Chennai

Figure 4.3: The Flip Side of Figures 4.1 and 4.2 - Modern Homestead Cattle Farm in Malappuram, Kerala

Source: AERC Chennai

The aforementioned case is a well equipped and modern cattle farm in Malappuram district of Kerala. This farmer is rearing cattle on a large scale (approximately 10 milching cattle) and also rearing milching buffalo that's very rare to find in Kerala. He is also a goat rearing farmer at the same time. As shown in Figure 4.3, his cattle sheds (there are more than one) are pucca including pucca roof, false sealing and fans to control heat, comforted floor (with mattress), tiled feeding space and grilled partition from each animal. However, Figures 4.1 and 4.2 shows the poor or no care for excess fodder being produced by him to feed his animals. Given the amenities and experience he had, he should have easily done post harvesting of the fodder production. However, he opined that the fodder cultivation itself laborious and expensive (by employing labor) and he may do the post harvesting in future when plan for a really large scale farm. According to him, that's the only occasion when full-fledged engagement with fodder crop is profitable in Kerala.

4.3 Needs and Suggestions

Given the peculiar situation of animal husbandry in the state, government aids have a crucial role in supporting the sector. Table 4.3 summarizes various aids received by the animal rearing farmers in the state. Milk subsidies as Rs.3 per litre in order to compensate the loss due to insufficient price in the market and spiking cost of feeds in the state is the most reported aid, which reveals its wide reach among farmers. Feed and fodder subsidies claims the second row of

Table 4.3: Benefits Received from the Government for Livestock Sector

Sl. No	List of Benefits	No. of Households Reported	Percentage
1	Cattle shed subsidy	2	0.92
2	Fodder subsidy	8	3.69
3	Fodder subsidy and loan	2	0.92
4	Loan for purchasing livestock	3	1.38
5	Agricultural loan	4	1.84
6	Milk subsidies	23	10.60
7	Feed Subsidies	4	1.84
8	Cattle shed maintenance support	3	1.38
9	Subsidy for fodder cultivation and milching machine	5	2.30
10	Milching machine and Grass cutter machine subsidy	1	0.46
11	Free cows from the cooperative society, as the part of 'Five Cow Scheme'	1	0.46
12	Subsidy for goat purchase	1	0.46

Source: Primary Survey

popularity and depicts the dependency of the farmers in purchasing them (than producing). Fodder subsidy may however be attributed to the seedling distribution, as an occasional popular scheme as discussed in the previous sector.

Notably, milching machine subsidy and grass cutter subsidy or fodder subsidy combinations are reported rarely, indicating that only large farmers are doing with serious fodder cultivation and processing. Milching machine purchase is a good indication of the farmer being large scale in Kerala. Similarly, subsidy and loan combination aid is also availed by a very few, confirming the trend. Loan or other aid to purchase cattle and goat are also reported by few of the farmers indicating a moderate spread of the scheme. Cattle shelter construction and maintenance assistances are also moderately popular and the maintenance assistance is an average of Rs.4000 as reported by a farmer. On the other hand, the shelter construction subsidy is relative to many factors including the land and farm capacity of the applicant farmer.

Though the queries of the survey were directly confined to the farmers' suggestions towards improving the fodder cultivation in the state, they have answered it in a way that the whole sector needs improvisation than treating the fodder sector in isolation. Those major suggestions by the farmers are summarized in Table 4.4. With regard to the livestock sector as whole, price of milk and feed moving extremely opposite directions unfavorably to the farmers. Most of the farmers report that the market price need to be increased by the government of regulatory authority and the existing price is not meeting the cost of cattle rearing. Similarly, ever increasing feed price need regulation by the government, farmers urge unanimously.

Demand for financial aid for feed, fodder, cattle shed and maintenance either in terms of subsidy or in terms of subsidized loans is the next popular suggestion by the farmers. This is a natural ion the agricultural sector that the stakeholders always look for financial aid as a matter of practice. Even if the subsidy volume is minuscule, farmers are usually motivated with that. Therefore, the most cost bearing items such as feed and cattle shed are the most sought after categories for subsidies. Here also, there is a demand for a subsidy to do the fodder cultivation as well, but only on a secondary priority. Given a choice, feed subsidy is preferred by farmers over others at any point in time. Need for credit support follows the next majority vote in a row.

Table 4.4: Major Suggestions to Improve the Livestock Sector and Production of Fodder Crops

Sl. No.	List of Suggestions	No. of Households Reported	Percentage
1	Need to increase the market price of milk	33	15.21
2	Need to reduce the market price of feed (mainly) and fodder	37	17.05
3	Need for credit support	11	5.07
4	Need for financial aid for feed (mainly) and fodder costs (including cultivation)	28	12.90
5	Need for financial aid for cattle shed construction and maintenance	16	7.37
6	Need for awareness programs related to fodder cultivation	3	1.38
7	Need for subsidy to purchase milching machine	3	1.38
8	Need for a feed (mainly) and fodder producing unit in Malappuram	3	1.38
9	Need to channelize feed and fodder supply through cooperative societies to reduce cost and ensure timely availability	2	0.92
10	Need to upgrade the medical support from veterinary centers concerned, in terms of importing high yielding cows, artificial semen sufficiency and quality, medicine sufficiency, etc.	2	0.92
11	Need for village wise fodder crop selling centers (for both saplings and output forage).	2	0.92
12	Need for regular and proper irrigation or water facilities	2	0.92
13	Need to integrate MNREGA should be integrated fodder cultivation to reduce cost of cultivation	2	0.92

Source: Primary Survey

With regard to fodder cultivation, there is a suggestion to create awareness and conduct training practices for fodder cultivation. Besides these suggestions, it is the call of time for that in the state. In this connection, need for proper irrigation facilities, village lever centers to sell and buy fodder products and integration of Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) scheme to fodder sector are suggested. The village centers are expected to deal the inputs for and outputs of fodder cultivation such as seeds, saplings, manure, equipments, storage, forage sale, etc. MNREGA integration is expected to reduce the cost of labor involved in fodder cultivation which is otherwise very high in the state. Channelizing the feed and fodder supply through cooperatives is a related suggestion to combat the price and availability issues.

Interestingly, farmers from Malappuram districts voiced for a feed production unit or factory in the district, in anticipation of reduced transport cost involved in feed and improved supply of feed in the district. Though such a unit in the district may not result in a straight price cut for the farmers in feeds, it may cater the need of timely and sufficient supply to them. Being a vast and thickly populated district and with a considerable size of all variety of livestock, the need has a justice dimension. In addition, the farmers expect that unit to demonstrate the fodder cultivation too, and to act as a nodal agency for the same in the district. Amid the land scarcity for fodder cultivation, these farmers suggest that this type of unit/factory (if they have a large campus) can act as the regular producer of fodder as well, so as the farmers can regularly meet their green fodder requirement from the same place of feed collection.

There are concerns with the veterinary sector also. Farmers observe that the veterinary centers need to upgrade the medical support from veterinary centers concerned, in terms of importing high yielding cows, artificial semen sufficiency and quality, medicine sufficiency, etc. Usually, large farmers are the victims of poor medical infrastructure in the locality, as one or the other animal is vulnerable to health concerns in a large farm. Also, large farmers seeks the help of these centers in buying good cattle to the farm, since most of the young stock and breeds to the state are being collected from outside Kerala. Precisely, farmers are concerned about the quality of their investment in such high cost cattle.

Meeting green fodder requirement through nontraditional ways such as using pineapple leaf, tapioca leaf or residue etc are another interesting suggestion from another farmer in Ernakulam district. Ernakulam is featured Vazhakkulam (popularly known as the Pineapple City) which produces a lot of leaves and other residues of pineapple each day. However, usually pineapple residues are not considered as green fodder for cattle. Framers from Ernakulam report that it is a good alternate and should be encouraged across state. Similarly, tapioca residues can also meet the purpose of green fodder where pineapple is not a popular crop. Tapioca is however been cultivated across the state. These types of alternates should come up and the authority should propagate the same along with giving awareness about potential merits and demerits of such alternatives.

The fodder cultivation subsidy is now given on rotational basis that is if farmer is availing subsidy for fodder cultivation in the current year, he or she will not be eligible for the subsidy in the next year. This situation demotivates farmers from cultivating fodder on a regular basis and there occur an explicit discontinuity in fodder cultivation with most of the farmers. That is not the purpose of giving subsidy for fodder cultivation. So this clause should be revoked and all farmers should be able to apply for the same regularly, so that the really interested farmers can sustain their fodder cultivation without much of hassle. Farmers say that, this subsidy should be given on regular basis for those who are interested in doing fodder cultivation than those are doing it on random basis just when they get the subsidy.

In order to increase the fodder cultivation practice in the state, the prime thing is to address the land availability. Farmers suggest that the regulatory bodies or the government should take necessary steps to get unused private lands for lease in the state. Currently, leasing in land, especially for fodder cultivation, is a big deal. There should emerge some collective mechanism to acquire wastelands in a particular locality for the purpose and such collective framings should serve the need for green fodder by all the members. Since the milk cooperative chains are so strongly established in the state already, those can act as the nodal agency for the lease-in matters also, if the government or regulatory bodies support them with a clear framework in this regard.

Chapter V - Major Findings and Policy Suggestions

5.1 Introduction

The feed and fodder sector in Kerala is facing a crisis situation as depicted through previous chapters of this study. On the one hand, the state is over dependent on feeds which are produced by imported inputs and on the other hand, the contributory cultivation (as source of feed inputs) has not been nourishing in the state yet. As the detailed description of this problem has already been shown through different chapters of the study, this chapter summarizes those details and suggests policy inputs to improve the sector.

5.2 Major Findings

The discussion on feed and fodder cannot be treated in isolation, and the policy level stakeholders should consider the livestock profile and trajectory of their composition from time to time. Especially in the case of a state like Kerala where the agricultural sector faces multifaceted threats, a comprehensive understanding of the scenario in a holistic manner is essential. The first and foremost in the line is the growing poultry sector at the cost of other livestock in the state, though the sector is not coming under the purview of this study. This situation implies that the feed production in the state in general need shifts as per the pattern change. For instance, having traditional feed and fodder availability or the inputs for them may not cater to the need of poultry sector which is a short term and meat driven sector.

While considering the live stock other than poultry in the state, cattle and goat rearing have considerable share when compared to buffalo rearing. Although both cattle and goat population in the state marks negative growth, the intensity of decline has reduced during last seven years. One another dimension is that the given homestead (backyard) animal rearing pattern of the state is more suitable or convenient for cattle and goat rearing per se. Moreover, cattle assure a daily basis income for the farmers through milk and goats fetches a seasonal lumpsum through breeding and selling them for meat or rearing market. Buffalo on the other hand fetches no regular income (Kerala has buffalo rearing popularly for meat market, not for milk market) and requires a relatively longer duration to meet the meat market requirements. Overarching to this, demand for both the milk and meat products in the state are growing positively.

In short, Kerala being a consumer state have a distinct pattern of animal rearing profile also. This sector also shows a progressive trend by the size of output produced through livestock rearing. However, the pattern and combination of livestock rearing is considerably different from the national picture. Thus the estimation of demand and supply of feed and fodder in the sector should consider the peculiarities in the composition of livestock population in the state over years. For instance, most of the farmers in the state rear more than one type of animal and hence they requires varying input supports than just fodder cultivation subsidy or cattle shed maintenance support.

Interestingly, the livestock rearing farmers are largely organized in the state under the umbrella of Milk Cooperative Societies (MCS). These centers act as a common platform for the farmers to have their concerns discussed, attended and resolved for most of the times per se. Even in the instance of a farmer is not giving milk to the particular MCS in his or her locality (thereby not a member of the MCS), she or he may also welcome to the society for their other needs such as subsidized feed and fodder. As already mentioned, most of the farmers in Kerala are rearing a combination of livestock such as cattle and goat or buffalo and cattle, etc. Thus the MCS umbrella covers most of these farmers irrespective of their nature of livestock rearing. However, the farmers in the state are reportedly old aged and school educated last generation people. No youth upsurge in the sector, as in any other agricultural and allied activity sector, has seen in the state.

On a similar note, female representation in the sector is largely underreported or manipulated by male counterparts. Although it is visibly seen that most of the livestock rearing (homestead or backyard) chores are being handled by women in the households, the reported male farmers are three times high than that of female farmers. There are instances where a large section of females responded to the survey reporting the credentials of their spouse only. A related aspect is that there is very minimal hired labor in the sector. Subsequently, the family involvement in livestock rearing is high as against the other agricultural involvement of the family. Altogether it is evident that the women involvement in the sector is as high as men, though they are unreported or underreported. On the other side, the usual farm agricultural works and not family involved and the agricultural income of the farmers stand high, mainly backed by the cash crops. Hence the associated male headship is reflected this side as well.

In Kerala, there is no problem of irrigation as many other states in India, predominantly due to abundant monsoon and dug wells. Thus there is no un-irrigated land as such in the state and the greenery (can be considered as green fodder) is aplenty. However, public grazing lands are rare to see in the state and most of the grazing demands are being met by neighborhood unclaimed land or a small (mostly private) river bank. Given the small scale backyard operation of animal rearing in the state, this option has potential to meet the green fodder requirement of the sector. This scenario demotivates the farmers from green fodder cultivation in the state.

The cropping pattern in the state is fundamentally unfavorable to the livestock sector. With the given priority of cash crops such as rubber (perennial) and pineapple (biennial), expectations of the livestock sector for feed and fodder inputs is almost zero. Paddy (seasonal) and coconut (perennial) are the two still standing traditional yet popular crops in the state which has something to offer for the feed inputs, either as residues or as a byproduct. However, the share of these crops in the state are declining at an alarming rate in recent years, mainly due to the loss pertaining to the output of these crops, which may again be referred back to high cost and poor extension in the agricultural sector of the state.

The livestock rearing pattern in the state have a regional dimension as well. The northern (Malappuram) and urban (Malappuram and Ernakulam) regions have a relatively more flavor with animal rearing for meat markets. Evidently, maximum number buffalo rearing farmers and large scale buffalo rearing are reported from Malappuram. In addition, male population is high in the buffalo rearing sector, as against cattle or goat rearing. Even with goat rearing, the second best meat option in the state market, the same regional concentration in rearing is visible too. Conversely, southern Kerala (Kollam) demonstrate a relatively more acquaintance with cattle rearing, including those indigenous varieties.

In general, milching animals have the highest requirements of feed and fodder in the state. Also, the detailed feeding is also followed for milching animals where the farmers ensures that almost all elements of the feed such as green, dry, concentrate and supplement are being fed to them in standard ratios. Crossbred cattle accounts for the most highest and precision feeding over all others. However, in buffalo rearing alone, male buffalos get higher proportion of feed, mainly due to male dominance for meat purpose in the category. Anyhow, the NATP standard estimation of requirement for feed and fodder per animal is way less than what farmers actually

feed them with. Therefore there is a course correction requirement to find whether the standards are being wrongly estimated (often a situation when Kerala is considered at par with other states of India) or the farmers are overfeeding (over reporting) them.

The standard estimation of feed and fodder availability in the state points that the state has manifold deficit of dry fodder and concentrates. The major reason behind the crisis is organic that none of the major contributory crops to feed and fodder making (input) such as wheat, sorghum, pearl millet, barley, maize, ragi, small millets, cereals, pulses, ground nut, etc are traditionally cultivated in the state. Paddy and coconut are the only major contributors to feed and fodder sector in the state, besides green fodder. Naturally, the state is forced to depend on other states to manage the huge gap in the supply of feed and fodder or their inputs. At the same time, this finding does not consider the actual availability of concentrate feeds as there is no database available on the same. Since the farmers in the state are highly pinned with such readymade feed to maintain their livestock, they may have given a better picture than the aforesaid estimation, which may be good for other states. However, given the constraint of data on production or import of concentrate feed in the state, we have no rooms left for the analysis for now. The only available data in this regard is about the public funded cattle feed (concentrate) production in the state, which is appended to this report (see Appendix 5.1).

On the other hand, green fodder seems galore in the state, suggesting a refocus of authorities from green fodder cultivation to other crucial problems of the sector including scarcity of other feed and fodder, especially concentrates, and their spiking rates. With the given monsoon and geography of the state, green fodder is available in multiples of requirement in the state, with zero cost. This is one of the prime reasons for no popularity for the fodder cultivation in the state. With the skeletal availability of land and relatively high cost of labor makes green fodder cultivation is highly unappealing in the state. Most of the reported fodder cultivating farmers does so as they are given with subsidies or substances for the same. Therefore it is high time for a rethinking on the same and to have a course correction to help the animal rearing people from the vulnerabilities of feed markets.

In addition to the greenery associated green fodders in the state, feeding household left over (food waste) is yet another major peculiarity of the homestead (backyard) animal rearing. This

particular component has also demand further scientific exploration, such as how much of the feed requirement can be supplemented by this or how much of the cost of rearing get waived by this. These factors, such as high green fodder availability and popular backyard farming could be exclusivity of the state and need deep diving in future, for improving the sector. At the same time, shrinking paddy and coconut cultivation poses an immediate risk for the livestock sector in the state, besides the food security in the state otherwise.

Kerala shows a 'pucca profile' as far as the animal shelters are concerned. Backed by the influence of intense habitat and other constructions in the state, animal shelters have adapted the same materials for their making and they are so pucca than what such a shelter expected to be. Such shelters resemble miniature of a regular habitat, including false sealing and fans to protect the stock from heat (if required). This strong and beautiful profile framework of the animal shelters has strong roots in the government aids as well. They are basically fuelled by the partial funding for animal shelter construction of maintenance and then get in fitness by the enthusiasm of farmers later. More likely, the basic amenities required for the shelters such as electricity and water are being shared by the farmers' house, which make such costs very marginal per se. In general, engaging labor force for the livestock maintenance is not there in the state. However, veterinary expenses are recurring and popular in nature, especially with the crossbred cattle.

Milking is the major source of income of animal rearing farmers in the state, except buffalo rearing where the income generation is predominantly happen through meat (animal) selling. In addition, a sizable farmer earns additional income through dung sale as well. Reportedly, there are no other sources of income for the farmers from the sector, such as breeding or value addition of milk. As the lion share of the farmers perhaps associates with the MCSs, they are disposing their milk production there and earn a corresponding value as per fat content in the milk. With the given scattered and marginal farm nature of the state, it is the most ideal case too. However, the farmers widely report about the lower cost for the milk while feed prices keep on shooting up.

Decreasing or subsidizing feed (concentrates) and increasing the price of milk is popular farmer suggestion in the state, which is sensible with the given condition of farmers in the state. Excepting the green fodder, every other aspect in the animal rearing in Kerala is costs involved,

which are often borne by the farmers themselves. Dry and concentrate feed, veterinary expenses, shelter expenses are the major concerns of the farmers in the sector, which needs immediate attention. Farmers demand more number of feed production units in the state with amble regional spread, so as to get the feed with the minimum possible price. Nevertheless, the alternate sources of crop residues as input such as pineapple residues are being exemplified by the farmers themselves, which now need authentic endorsement. It may help in handling the concerns of feed and fodder sector in the state in the long run.

5.3 Policy Suggestions

- The feed and fodder sector is essentially a part of larger agricultural framework, so the agricultural sector as a whole need improvements to have reflections in the feed and fodder profile of the state. Therefore the expansion of cash crops and decline of food crops need to be closely watched in the first place.

- The feed and fodder sector assistance in the state need a course correction through understanding of their nature of survival. Given the abundant availability of green fodder in the state with zero cost, now the focus of the assistance should shift from assistance for green fodder cultivation to other feed and fodder segments.

- The existing schemes or assistance offered for the green fodder cultivation should be revoked or revisited after making a detailed case study. This scheme can be altered for large farmers alone or for those who have substantial fallow (land for lease or otherwise) availability coincide green fodder scarcity.

- As there is a huge deficit for the feed (concentrate) and dry fodder in the state, the regulatory bodies should take necessary actions to bridge the current gap on an urgent basis. Since this gap is going to be widened in the future as the contributory crops keep attenuation year after year, the authorities should focus on strategies to tackle the same both in the long run and short run, with an intention to keep the burden on farmers minimal.

- In assisting the farmers, first preference should be given to the subsidized feeds as it is the most costly component (recurring component) of livestock rearing in Kerala. Financial aid for the same otherwise may not meet the purpose as subsidy do.

- The other cost reduction alternative is to make use of the collective structure of MCSs in the state in the forms of bulk purchase and bargaining or starting with feed production units. In the former one, the regional MCS or a group of MCS would do the feed purchase for the farmers under them and target for a lower price with their capacity to order huge volume on a regular basis. In the latter, the MCS or a group of them can come forward for setting up a unit of feed production, so as to supply low cost feed for the farmers under them. Boarder places to Tamil Nadu would be a better avenue for the latter suggestion, while others may try the collective lobbying in the former one. However, both the alternatives have their own advantages and drawbacks which may vary from place to place.

- As the inputs for feed production in the states are substantially low, the authority should think about long term plans such as hiring or constructing feed production units in other states or long term contracts for the supply of feed inputs from other state units at a minimum price. This step is crucial given the anticipated shrinking of food crops in the state.

- Possibilities of expanding the input range by other substances such as abundant green fodder, pineapple residue or food residue need to be explored, as they are already being fed to animals in raw form. Research and development should focus more on this area, as they can come up with profitable alternatives within the state in future.

- The homestead (backyard) style of animal rearing should be encouraged, through animal differentiation and financial assistance for the same. Given the land scarcity and cash cropping pattern of the state, a large farming based models would be limited a few large farmers who can survive on their own, exploiting the positive externalities of operating on large scale.

- As the meat market is quiet progressive in the state, animal rearing for the market both on large scale and small scale should be encouraged. Therefore, attention to the buffalo rearing and goat rearing sectors need a hike, at least as in the case of cattle rearing. Unlike cattle sector, both the sectors have no umbrella unifying agency like MCS and meat market related stock rearing in the state is a largely done on individual basis. Bringing the concerns of the sector in a common platform like MCS could boost up the sector both in terms of number of farmers and their earnings.

- Given the already built strong infrastructure in the home based animal rearing, these small and marginal farmers should be motivated to have additional rearing (from a different category, especially for meat market) along with their regular animal portfolio. For instance, the practice of rearing (nurturing for instance) one male buffalo along with regular cattle portfolio is a common practice in Malappuram district, which help the farmers in earning an additional lumpsum amount occasionally, with a comparatively less marginal cost for the one additional buffalo. This model can be replicated in other portfolios and combinations as well.

- Goat rearing is also a related untapped potential area for the farmers as the sector may sustain only with green fodder and homestead food wastes unlike cattle and buffalo. Goat rearing reportedly use negligible concentrate feeds or use locally available concentrates only when there is a large rearing. So adding up goat rearing to the existing cattle portfolio can be additional income generating source for the farmer while having a negligible marginal cost (excluding shelter cost if any).

- Attracting youth in to the sector is crucial in survival of the sector which requires constant societal campaigns and governance programs to realize. The pathetic youth and women representation in the livestock sector is partly due to the unattractiveness of the economic profile of the same. Given the Covid-19 pandemic situation and large return migration to Kerala, the livestock rearing sector can act as one of the crucial means for survival of such households and youth, if planned and executed properly.

- Coordination of different departments associated with animal rearing viz Agriculture, Dairy Development, Animal Husbandry, etc. in the state need to be integrated and

strengthened. As these entities act in isolation with their programs and policies, only a meager benefit is happening to the farmers. Should they have been coming under single umbrella, results would have been much better. In the instance of coordinated acting, the priority should be given for a mixed rearing, that is rearing for both milk and meat markets in order to maximize the profit of the farmers.

- As the Government of Kerala has already proposed an Act to regulate the sale and quality of cattle feed in the state, the Act should also consider the demand and supply side of the same, with probable solutions for the gaps from time to time. Most importantly, a system for maintaining the statistics of the feed and fodder availability in the state (including private production or import from other states) need to be considered in the special context of the state where the large chunk of farmers are dependent on the market driven feeds.

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Appendixes

Appendix 1.1

Agro-Economic Alerts

Aiding the future of India's farmers and agriculture

(Photo Source: www.stackpathcdn.com/media/10313/dairy-farming-technology.jpg)

For kind attention of:

The Hon'ble Prime Minister's Office,
the Ministry of Agriculture and Farmers Welfare,
and all others interested

Emerging Critical Situations and Threats in India's Agricultural Economy

Issue 11, May 2019

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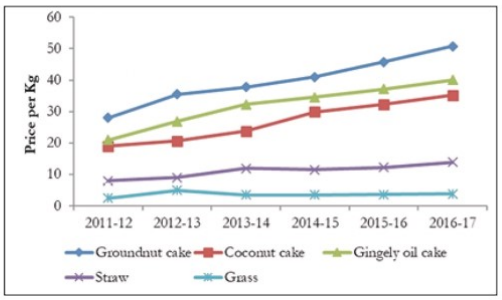
Price Hike of Feed and its Effect on Dairy Sector in Kerala

Key highlights

- In Kerala, the demand for feed and fodder far exceeds its availability, pushing up the prices of feed, especially of the concentrates. (Figure 1).
- As a result, local milk prices have increased. Farmers under Milma (also known as the Kerala Co-operative Milk Marketing Federation), get Rs. 34.5 per litre of milk which is then processed and sold at market at a rate of Rs. 42 per litre.
- Milk from Tamil Nadu which costs Rs. 22-23 per litre is available in plenty in the border places and the intermediaries get it on wholesale and sell it in the state for the same market price of Rs. 42 per litre. Since this practice fetches a very good profit for the agents, the milk price hike in the state indirectly helps this parallel market and distorts domestic dairy economy.

Figure 1: Trend in Average Prices of Feed and Fodder from 2011-17.



Source: *Kerala Economic Review 2017 & Animal Husbandry Department, Government of Kerala.*

Observations

- Kerala Feeds Limited (KFL) which occupies 40 percent share of the cattle feed market in the state and is largely responsible for regulating cattle feed prices in the state has incurred operating losses of Rs. 72 crores since 2015 on account of input price increase.
- The demand for cattle feed in the market had shot up as a result of the popularity of Central Government's Rashtriya Gokul Mission programme in northern India which offers cattle feed for free. This resulted in increased demand for raw materials for the cattle feed production by a number of new firms in the market. Since most of the raw materials for the production of cattle feed are not available in Kerala and about 90 percent are imported from other states, the rise in price for these inputs has seriously affected the dairy sector in the state.
- Kerala has no grazing lands and hence the fodder availability such as straw (dry fodder) is poor, which makes it almost impossible to maintain cattle without giving feed in concentrate form. Tamil Nadu has abundant agricultural wastes (such as corn residues) as it is a major vegetable producer which helps them in reduced need for concentrate cattle feed. As a result, the total cost of producing milk in Tamil Nadu is relatively less.
- Hence, the dairy farmers in Kerala are hit by the KFL's price hike. KFL has no subsidy or grant. According to the KFL officials, the prices of raw materials like maize, oil-less chaff and rice cake, soybean and molasses used in feed production have gone up by as much as 35 percent since December. However, KFL has affected a hike of Rs. 25 per packet since then, which means the company still loses Rs. 65 per packet on an average.

Figure 2: Cattle Being Given Feed in a Dairy.

Source: *www.godrejagrovet.com*

- In the wake of the existing loss to the company, the subsidy for farmers coming under Milma umbrella for Rs. 100 per 50 kg sack has also been stopped. KLF feed is the cheapest feed available in the market with a minimum price of Rs. 1045 per 50 kg sack. At this price, KLF had incurred a loss of Rs. 10 crores during last year.

Actions suggested

- Considering the peculiar situation in the state, Rashtriya Gokul Mission in the state should include feed and fodder distribution/subsidy as one of the components within it.
- The state government should take action to remove intermediaries in the dairy market. Government or the concerned authority should step-in for importing additional milk from other states on a standard rate, which will automatically eliminate the intermediaries present.
- A justifiable price for milk should be assured by the state government for farmers, subject to controlling the import of cheap rated milk from neighboring states.
- The state government should start providing support for those who come with agricultural startups, especially with regard to production of concentrate feed.

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Appendix 1.2

Sampling Framework as originally given by the Coordinating Centre (ISEC Bangalore)

State, Coverage and AERCs

The study will be conducted in the following states viz., West Bengal, Haryana, Gujarat, Rajasthan, Karnataka, Kerala and Uttar Pradesh by respective Agro- Economic Research centers. The Selection of states for conducting the study is as suggested by Ministry of Animal Husbandry, Dairy and Fishery, Government of India. For the study, districts will be selected based on the Livestock population from the available secondary data. The proportionate sampling technique will be applied for sample size in districts in selected states.

To select districts for the study in every state firstly we have collected district wise animal population. Based on the size of the population of Cattle, Buffalo Sheep and Goats ranks has been given to individual districts later we have taken average of the obtained ranks of individual district. The districts having top three ranks were selected representing different regions of every state for the study. In every selected sate total of 120 Cattle rearing farmers, 120 Buffalo rearing farmers and 120 Sheep & Goat rearing farmers will be surveyed with a pre prepared questionnaire. The number of farmers going to surveyed is mainly based on proportion of cattle, Buffalo and Sheep & Goat population existing in the district i.e. in selected districts of every state based on proportion population sample size is determined. Villages will be 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 will be considered as more than one sample.

Table A1: Sample States based on Willingness of AERCs Participated

AERCs	States	Districts	Cattle	Buffalo	Goat &Sheep	Total
AERC, VV Nagar	Gujarat	Banas Kantha (north)	60	64	42	166
		Panch Mahals (central)	42	40	62	144
		Surat (south)	18	16	16	50
		Subtotal	120	120	120	360
	Rajasthan	Barmer (western)	44	73	77	194
		Ajmer (Eastern)	22	19	20	61
		Udaipur (southern)	54	28	23	105
		Subtotal	120	120	120	360
AERC, Delhi	Haryana	Bhiwani (south)	31	46	47	124
		Hisar (north)	38	44	33	115
		Sirsa (central)	51	30	39	120
		Subtotal	120	120	120	360
ADRTC, ISEC, Bengaluru	Karnataka	Chitradurga(central)	23	16	51	90
		Belgaum (north)	48	89	57	194
		Hassan (south)	49	15	12	76
		Subtotal	120	120	120	360
AERC Chennai	Kerala	Ernakulam (central)	44	40	40	124
		Malappuram (north)	34	62	44	140
		Kollam (south)	42	18	36	96
		Subtotal	120	120	120	360
AERC Allahabad	Uttar Pradesh	Bahraich (Eastren))	46	47	46	139
		Kheri (Central)	56	44	43	143
		Agra (western)	18	29	31	78
		Subtotal	120	120	120	360
AERC Visvabharthi	West Bengal	Murshidabad(South)	28	40	41	109
		Maldah(North)	23	28	33	84
		Paschim Medinipur (western)	69	52	46	167
		Subtotal	120	120	120	360
Grand Total			840	840	840	2520

Appendix 3.1

Detailed Methodological Framework as given by the Coordinating Centre (ISEC Bangalore)

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 will be collected from the **Department of Animal Husbandry and Dairying**, Government Indiafor different species viz., cattle, buffalo, sheep and goat for the census periods 2007, 2012 and 2017. Further, secondary data on the area under fodder will be collected from various issues of Land Use Statistics and also from the concerned Department of Animal Husbandry, Dairy and Fishery of selected states for the study.

To understand and analyze the demand for and supply of feed and fodder will be collected from the field levelthrough a sample survey method. The reference period of the study will be 2018-19 agricultural year. The household survey will cover 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 will be collected, scrutinized, tabulated and analyzed by employing various analytical tools. The suitable analytical tools will be employed for analysis of data as discussed briefly in the following subsections.

The percentage difference will be estimated to analyze the growth pattern between the inter-census periods of the livestock census for major livestock viz. cattle, buffalo, sheep, and goat for the recent two periods of livestock census. Similarly growth rates will be calculated to change in the area, production and productivity of major fodder and dry fodder crops.

Estimation of Demand and Supply of feed and fodder

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 A2**. 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 would be 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 would be 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 A2: Green Fodder Yields for Land Use Classification

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

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

Dry Fodder and 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 crop residues, oil cakes, brans and chunnies of various fodder related crops would be estimated by the following conversion formulations (**Table A3**). 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 will be 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:

$\sum_{ij} [\![QCij)^{mn} = Yij * HIij \text{ or } ERij$

Where,

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

Yij = Yield of crop i in district j

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

Table A3: 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.

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			

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

Total Availability of feed and fodder: The dry matter in green fodder, dry fodder and concentrate will be 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***).

Requirement of Feed and Fodder (Demand)

The estimation of demand of feed and fodder will be 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) will be considered to find out the Ruminant Livestock Unit (RLU). This Livestock population in the state will be converted into a standard Ruminant Livestock Unit (RLU) according to species, age and sex (male and female) as per ***Ramachandra et al., 2007***studyand **FAO** Animal Production and Health manual. The estimation of feed requirementforthe livestock will be 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) will be 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(2012), FAO (2012), and Ramachandra et al.,(2007)***. The following conversion factors will be used for calculating the RLUs as given in **Table A4**.

The total requirement of feed and fodder will be calculated using the standards given by the NATP database as provided in Table A5. The animals' category-wise data will be collected from the Animal Husbandry Department and the requirement of feed and fodder will be calculated individually and the aggregate demand will be calculated by summing up of all categories.

Further, an attempt will also be 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 districts and their population is given in **Table A1**.

Table A4: 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 A5: 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

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,

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

Appendix 5.1

Table A6: Production of Cattle Feed (Concentrates) in Kerala (2014-19)

Factory	Production in Lakh MT				
	2014-15	2015-16	2016-17	2017-18	2018-19
Pattanacaud (KCMMF)	0.52	0.637	0.67	0.57	0.266
Malampuzha (KCMMF)	0.52	0.588	0.58	0.55	0.51
Erode CPA	0.2	0.245	0.27	0.50	0.645
Kerala Feeds Ltd.	2.37	2.50	2.19	1.91	2.19
Total	3.61	3.97	3.71	3.53	3.611

Source: Kerala Economic Review 2019

Appendix X.1

Images from the Field Survey for the Study in Kerala (2019-20)

Figure A1: A Semi-Pucca Cattle Shelter from Malappuram, Kerala

Source: AERC Chennai

Note: A semi-pucca cattle shelter is the most common type of cattle shed in Kerala. They have the basic structure of a pucca shelter, but deteriorated and then patched by kachcha items. Relatively poor and small scale animal rearing farmers maintain these kinds of shelters until they are completely deteriorated or aided for renovation. A pucca cattle shelter as shown in Figure 4.3 (Chapter 4) is usually affordable for large scale and relatively established farmers. Most of the homestead cattle rearing are being managed through these semi-pucca sheds.

Figure A2: Front and Back Views of Semi-Pucca Goat Shelters from Malappuram, Kerala

Source: AERC Chennai

Note: Similar to cattle shelters, semi-pucca goat shelter is the most common type of goat shelter in Kerala. They usually have the pucca wooden basic structure, but deteriorated and then patched by kachcha items. Relatively poor and small scale animal rearing farmers maintain these kinds of shelters until they are completely deteriorated or aided for renovation (either by them or by government).

Figure A3: A Pucca Goat Shelter from Malappuram, Kerala

Source: AERC Chennai

Note: This modern pucca goat shelter is partly aided by the local government and cooperative societies. As against the usual wooden basic structure, these are iron and aluminum sheet combination which ensure a comparatively long life of this shelter. However, such aids are raee to find and this model is yet to be popular among farmers. Farmers feel that the safety of goats is assured under this type of shelter, especially in such locations where wild animals and stray dogs attacks goats over night.

Figure A4: A Kachcha Buffalo Shelter from Malappuram, Kerala

Source: AERC Chennai

Note: Buffalo rearing has the poorest infrastructure among animals. They are being reared primarily for meat purpose, so as given with minimal facilities. The picture shows an almost kachcha buffalo shelter from farmer in Malappuram. The same farmer has a pucca cattle shelter and goat shelter in addition to this. The only pucca component in this structure is the asbestos sheet roof which is being the cheapest among roofing materials and relatively lasting too. The actual kachcha roofing is costly in Kerala due to two reasons. One is that the material is rare to find and the second is that the six month long rainy season in the state will easily deteriorate the roof in a minimum time.

Figure A5: A Typical Milk Cooperative Society Office cum Milk Collection Point from Ernakulam, Kerala

Source: AERC Chennai

Note: This is Thirumarady Milk Cooperative Society form Ernakulam district and the office depicts a typical milk cooperative society in the state. The front office (room) serves multi purposes such as office of head, milk collection point and the farmer-cooperative interaction interface. However, there is extra space or rooms for regular massive meetings and trainings besides the necessary space for storage and equipments in the society.

Figure A6: A Well Equipped Milk Cooperative Society from Kollam, Kerala

Source: AERC Chennai

Note: This is Chirakkara Edavattam Milk Cooperative Society form Kollam district of Kerala. This society depicts a modern and well equipped milk society in the sector. In the clockwise look, there is (1) a huge cold storage facility established, (2) a spacious front office cum milk collection point (including smart information interfaces established) and (3) mini lab for checking quality of milk being collected and stored. In addition to these, there is meeting and other spaces with all necessary equipments required.

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