Study Number - 191

ASSESSMENT OF LIVESTOCK FEED AND FODDER IN THE STATE OF WEST BENGAL

Bidhan Chandra Roy
Bitan Mondal
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Study sponsored by Ministry of Agriculture and Farmers Welfare
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Agro-Economic Research Centre
(For the States of West Bengal, Sikkim and Andaman & Nicobar Islands)
Visva-Bharati, Santiniketan
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Preface

The present study entitled "Assessment of Livestock Feed and Fodder in the State of West Bengal" has been assigned by the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi with full financial endorsement and under the close coordination of Agricultural Development and Rural Transformation Centre, Institute for Social and Economic Change, Bangalore, Karnataka.

Most of the rural poor in West Bengal are dependent on mixed crop-livestock farming system for their livelihood. Livestock rearing plays a major role in supplementing family income and generating gainful employment, particularly among the landless laborers, small and marginal farmers and especially women. But scarcity of feed and fodder is also a serious constraint for development of this sector in the state. The availability and efficient use of feed resources are the primary drivers to maximize the livestock production and productivity. There is a lack of reliable estimates for availability and requirements of feed and fodder at state level. The FAO standards of feed requirements are based on animal body weight but available only for dry matter. The NATP standards are average for whole of the country and are available only for four different categories of cattle and buffaloes. However, actual feeding practices differ across the regions as well as livestock species; breed types, stages of life, feeding practices, age and sex of the animal. Therefore, assessment of livestock feed resources based on actual feeding practices at state level are very important for effective planning and policymaking for this sector.

During our course of investigation, we find that actual amount of feed and fodder fed to different species of livestock is significantly different from both the NATP standards as well as FAO standards. The results of the study find that there are three distinct constraints to the development of livestock sector in West Bengal. One, predominance of indigenous breeds with low productivity; second serious constraints is acute shortages of feed and fodder; and third important constraint is inadequate livestock extension services in the state. Empirical studies have shown that enhancing quality and quantity of feed and fodder input has greater impact than breed improvement on increasing milk productivity in the state. Therefore, augmentation of feed and fodder production is the most challenging constraint that needs to address immediately.

The task of completion of this study was assigned to Prof. B. C. Roy for overall coordination and to Dr. R. K. Biswas for field survey and to Dr. Bitan Mondal and Mr. A. Roy for compilation of secondary data. The study team also consist of Mr. D. Majumder, Dr. D. Roy and Mr. K. S. Chattopadhyay for field survey. Collection, compilation and analysis of secondary data were done by Prof. B. C. Roy, Dr. B. Mondal & Mr. A. Roy while that of household survey data was done by Dr. R. K. Biswas (and by Mr. A. Roy for the unfinished part). Drafting of the report was done by Prof. B. C. Roy, Dr. B. Mondal, Mr. D. Majumder, Dr. R. K. Biswas and Mr. A. Roy. Secretarial assistance for the study was provided by Munshi Abdul Khaleque, Mr. Nrityananda Maji, Mr. D. Mondal, and Mr. D. Das. Mr. B. Singh and Mr. S. Hansda also extended support in office maintenance.

We convey our sincere gratitude to Dr. Sabyasachi Ojha and Mr. Amiran Choudhury, Azimganj Rai Budh Singh Bahadur High School for their help and cooperation in conducting field survey. We also take this opportunity to thank the officials of the Animal Resource Development Department, Government of West Bengal for their kind help and cooperation in carrying out the study.

We acknowledge the niceties of Prof. Bidyut Kumar Chakraborty, Vice Chancellor, Visva-Bharati and Shri P. C. Bodh (Adviser-AER Division) of Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi for their guidance and necessary support in completion of the study.

We are extremely thankful to Prof. I. Maruthi, ADRTC, ISEC, Bangalore for his effective and encouraging coordination of the study. A word of appreciation is not sufficient for his candid suggestions and comments on the draft of this report. And finally, we convey our sincere gratitude to the hundreds of livestock farmers and extension workers in the study districts for their ungrudging responses to our questions for the days together.

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Background

One of the pillars of the West Bengal's economy is the animal husbandry and dairy sector. The importance of the livestock sector in the economy of West Bengal can be judged from the fact that it contributes nearly 20.34 per cent of the state's total agricultural production (AgSDP). It is pertinent to mention here that employment opportunities in traditional agriculture sector are shrinking rapidly and there is virtually no scope for employment of rural unskilled youths in capital intensive industrial units. On the other hand, due to ever increasing population growth and changing food habits, demands for milk, meat, egg & other livestock related products are growing fast. Livestock rearing is therefore can be a major source of livelihood, particularly among the landless laborers, small and marginal farmers, and especially women in West Bengal.

Availability and efficient use of feed resources are the primary drivers to maximize the livestock production and productivity. But there is a lack of reliable estimates for availability and requirements of feed and fodder at state level. The FAO standards of feed requirements are based on animal body weight but available only for dry matter. The NATP standards are average for whole of the country and are available only for four different categories of cattle and buffaloes. However, actual feeding practices differ across the regions as well as livestock species; breed types, stages of life, feeding practices, age and sex of the animal. Assessment of livestock feed resources based on actual feeding practices at state level are very important for effective planning and policymaking for this sector. Therefore, considering the magnitude of dependence on livestock sector in West Bengal in one hand, and low animal productivity on the other hand, the present study was undertaken to assess livestock feed and fodder resources in the state with the following objectives.

Objectives of the study

The study was conducted in the state of West Bengal with the following specific objectives:

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

Study design

The study was based on both secondary information and primary survey. Primary survey was carried out in three districts of West Bengal, namely, North 24-Parganas, Burdwan and Murshidabad covering 120 sample farmers each for cattle, buffalo, and goat.

Major Findings of the Study

The major findings of the study are as follows:

1. The state of West Bengal is home to 37.48 million livestock which is 4th largest number in the country. However, most of livestock are indigenous (82.46 per cent) in nature which is one of the important constraints to boost up the productivity.

2. Indigenous cattle and goat dominates the livestock sector in West Bengal, together they constitutes more than 85 per cent of total livestock population in the state. While cattle accounted for 50.92 per cent of total livestock in the state, goat accounted for as high as 43.44 per cent against the national average of 27.80 per cent only.
3. It is encouraging that crossbred cattle have been increased by 21.33 per cent and that of female crossbred by a whopping 33.74 per cent during last 7 years. However, total numbers as well as relative share of buffalo, sheep, pig and other livestock showed a declining trend during last five censuses.
4. Rural people in West Bengal are highly dependent on mixed crop-livestock farming system for their livelihood. Crossbred cattle and buffaloes are mostly reared with commercial motive for milk production and goat for mutton. Rearing indigenous cattle is an important part and parcel of subsistence farming in meeting both the requirements of milk and animal power for farming operations.
5. Livestock rearing in West Bengal is a highly labour intensive and profitable enterprise primarily run by the family members, particularly women. Livestock rearing plays a major role in supplementing their family income and generating gainful employment.
6. Besides fish and rosgolla, West Bengal has an insatiable appetite for goat meat, chicken and eggs. Therefore, both goat and poultry farming represents a golden opportunity for off-farm livelihood diversification for unemployed youths in the state.
7. Production of egg is growing at an annual rate of 13.54 per cent per annum in West Bengal. The growth rate in meat production is also more than 5 per cent per annum. However, growth in milk production as well as milk yield in West Bengal is much lower than All India averages. Production of wool is very negligible in West Bengal.
8. Goat rearing is very much profitable and has huge economic potentiality. Because of low rearing cost, low initial investment, early maturity (at the age of 10–12 months), short gestation period, and above all delicious meat and high quality skin, rearing Black Bengal breed of goat is very popular among the poor farmers of the state. They can efficiently survive on household waste, and available shrubs and trees.
9. There is severe feed and fodder scarcity at household level. On an average, the livestock farmers could produce only 40 per cent of their feed requirement. This is a matter of serious concern as the quantity and quality of feed resources are the primary drivers to maximize the livestock production and productivity.
10. West Bengal is an acute fodder deficient state. It is partly due to non-availability of fodder land which is far below the all India average, and partly due to lack of adequate pasture and grazing land. Only 0.07 per cent of the total land is available for pasture and grazing in the state. Total area under fodder crops in West Bengal is only 0.04 per cent of gross sown area as compared to a national average of 4.6 per cent.
11. Availability of feed ingredients is also bleak. Estimated availability of green fodder, dry fodder and concentrates in the state is 2.29 million tonnes, 27.14 million tonnes and 3.10 million tonnes, respectively. Availability of feed and fodder in terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) are estimated at 27.87 million tonnes (MT), 16.63 million tonnes (MT), and 1.18 million tonnes (MT), respectively.

12. There exist a huge gap between availability and requirements of all types of feed resources, particularly, green fodder, dry fodder and in terms of TDN & CP. This is a matter of serious concern for the development of livestock sector as both the quantity and quality of feed resources are primary drivers to maximize the livestock production and productivity.
13. As per NATP standards, the state falls short by 27.45 MT of green fodder which is as high as 92.30 per cent of its total requirement and by 1.00 MT (3.55 per cent of requirement) of dry fodder. However, the state is self-sufficient in concentrate feed with a surplus of 0.34 MT (11.93 per cent of requirements). The deficit in terms of DM, TDN and CP is estimated at 7.46 MT, 14.87 MT and 1.96 MT, respectively.
14. As per FAO standards, total dry matter requirement in the state is estimated at 33.74 million tonnes against the availability of 27.87 MT, resulting a shortfall of 17.40 per cent of total requirement.
15. Actual feed consumption rates in the study area are different from the NATP standards. Actual rates are slightly lower for green fodders but significantly higher for dry fodder and concentrates. As per actual feeding practices, total annual requirement of feed and fodder in West Bengal during 2019 is 69.03 MT against the total availability of only 32.62 MT i.e., there is a deficit of 52.75 per cent.
16. Bulk of the feed requirement, as expected, came from cattle. Though the share of goat in total livestock population in the state is as high as 43.44 per cent, its share in the total requirement of feed and fodder is only 4.22 per cent of dry fodder, 12.52 per cent of concentrate, and 20.78 per cent of green fodder in West Bengal.
17. Due to small farm subsistence farming, farmers are not inclined to put their scarce land into fodder cultivation because of household requirement for staple food and low returns from fodder cultivation. However, majority of livestock farmers are eager to take up fodder cultivation and interested in learning post harvest management techniques of fodder crops, but unable to do so due to lack of technical knowhow about fodder cultivation and post harvest management, non-availability of quality seed, low productivity, and high cost of fodder seeds.
18. There are several programmes for livestock development in the state but very few livestock farmers actually benefited from such schemes. Main benefit derived by them is free advice from the block veterinary surgeon on livestock diseases. Only 8 per cent sample farmers received free vaccination and training and a mere 3.33 per cent received benefits from artificial insemination (AI) programme. However, as high as 42.67 per cent household did not receive any kind of benefit, not even free advice.

Policy Recommendations from the Study

The finding of the study shows that there are three distinct constraints to the development of livestock sector in West Bengal. One, predominance of indigenous breeds with low productivity; second serious constraints is acute shortages of feed and fodder; and third important constraint is limited reach/coverage of livestock extension services in the state. However, livestock rearing is a highly labour intensive and profitable enterprise in West Bengal. Therefore, based on the findings of the study, the following policy interventions are suggested for sustainable development of livestock sector in West Bengal:

1. Increase feed and prodder production in West Bengal: The findings of the study have amply demonstrated that there existed an overall shortage of all types of feed resources and in order to increase feed and fodder availability in the state following interventions are suggested.
    - Arrange training programme to popularize fodder cultivation
    - Ensure timely availability of quality fodder seed at subsidized rate
    - Promote maize and other fodder crops to meet the growing feed demand
2. Breed Improvement: Since as high as 82.46 per cent of livestock in West Bengal are indigenous breeds with low productivity, breed improvement is must to boost up the animal productivity. And for that the following interventions are needed.
    - Increase coverage under crossbred cattle through the production of superior quality bulls.
    - Upgrading indigenous cattle through the production of superior quality semen and extensive coverage under artificial insemination programme.
    - Upgrading Black Bengal goat through selective breeding with high yielding purebreds.
    - Replacement of old bucks/rams/bulls for the promotion of profitable goat/ sheep/cattle farming among the smallholder farmers.
3. Livestock Extension Services: Inadequate coverage of livestock extension services in West Bengal remains a major area of concern. There is a felt need of various extension services in the state like:
    - Training on fodder cultivation and post harvest management
    - Promotion of balanced feeding with mineral fortified feed mixture
    - Encouraging commercial livestock farming
4. Others: The animal husbandry and livestock sectors are critical for the rural economy, especially for the land less labourers, women, and small and marginal farmers. Therefore, there is a need to ensure the followings.
    - Promote backyard poultry and rearing Black Bengal breed of goat as they represent a golden opportunity for off-farm livelihood diversification for unemployed youths in the state.
    - Conserve the world famous meat type prolific Black Bengal breed of goat, adopting a definite breeding policy is urgently required.
    - Promote FPOs in Livestock for procurement of inputs as well as marketing of animal products.
    - Ensure provision for animal shed to keep the animals stress free.
    - Promote processing facilities for dairy and livestock products in the state.
    - Demand for a separate National Livestock Policy with greater emphasis on feed and fodder.

Conclusion

Livestock rearing is one of the most important economic activities in West Bengal but scarcity of feed and fodder is a serious constraint for the development of this sector. Predominance of indigenous breeds with low productivity; and poor reach of livestock extension services adds to the problem. The share of crossbred livestock population is increasing in West Bengal, but the state is not able to raise feed and fodder availability due to the heavy pressure of growing staple and commercial crops. However, augmentation of animal productivity is the most challenging constraint that needs to be addressed immediately. And for this, increase in feed and fodder along with breed improvement is a must. The present study estimated feed and fodder availability and requirement based on NATP standards as well as actual feeding practices followed by the livestock rearing farmers in West Bengal. Since there was hardly any reliable estimate at state level, these state level estimates will provide a sound basis for determining the input output relations for the livestock sector in West Bengal and in effective planning and policymaking for this sector.

Chapter – I

Introduction

Agriculture and animal husbandry in India are interwoven with the intricate fabric of the society in cultural, religious and economical ways as mixed farming and livestock rearing forms an integral part of rural living. Although the contribution of agricultural sector in the Indian economy is steadily declining (from 36.4 per cent in 1982-83 to 16.5 per cent in 2019-20), the agriculture and livestock sector still provides employment to 52 per cent of the work force. Livestock provides draught power, rural transport, manure, fuel, milk and meat. Most often, livestock is the only source of cash income for subsistence farms and also serves as insurance in the event of crop failure. Further, global energy crisis will lead to utilization of livestock-based bio-energy as well as waste recycling for organic manure and organic forage production for quality animal products. India supports nearly 20 per cent of the world livestock and 16.8 per cent human population on a land area of only 2.3 per cent. It is leader in cattle (16 per cent) and buffalo (55 per cent) population and has world's second largest goat (20 per cent) and third largest sheep (5 per cent) population. The animal husbandry sector that accounts for about 4 per cent of the national GDP is an important means of livelihood security in the country. In the past two decades, with the manifestation of the continuous deceleration in rate of production growth of most of the food and non-food grain crops, the role of livestock sector, particularly that of dairy has become vital in maintaining the growth in agriculture sector. The approach paper of the XII Five Year Plan reiterates that for achieving targeted growth rate of 4 per cent in agriculture during the Plan period, while the crop production is anticipated to grow by about 2 per cent, it would be horticulture, livestock, dairying, poultry and fisheries that would grow at 5 to 6 percent and be the harbinger of agricultural growth. It is imperative that the rate of production of animal food is required to increase substantially to cope up with the expected rise in its demand in future.

Animal feed and fodder is the most crucial input in livestock production. Empirical studies in India have shown that enhancing quality and quantity of feed and fodder input has greater impact than breed improvement on increasing milk productivity (Lalwani, 1989; Gaddi and Kunal, 1996). The shortage of feed and fodder is a serious constraint in increasing the productivity of livestock in India. The assessment of availability of feed resources in India brings out two important points: one, over a period of time, with increase in agricultural production the animal feed availability has also improved (Singh et al., 1997; Sampath et al., 2005) and two, despite of the increase its supply falls short of the aggregate nutritional

requirement of feed by livestock population (Singh and Majumdar, 1992; Jain et al., 1996; Angadi et al., 2005; GoI, 2012). At the all-India level, the estimated deficit of dry fodder, green fodder and concentrates is 10, 33 and 35 per cent respectively, which are likely to be increased to the corresponding extent of 11 per cent, 35 per cent and 45 per cent by 2020 (GoI,2012). In the next decade, the feed balance may worsen further as production of green fodder is projected to decline by 2030 (Suresh et al., 2012).

1.1 : Background of the Study

Fodder production and its utilization depend on the cropping pattern, climate, socioeconomic conditions and type of livestock. The three major sources of fodder supply are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands. At present, the country faces a severe deficit in almost all major feed components (green, dry and concentrate). The situation is further aggravated due to increasing growth of livestock particularly that of genetically upgraded animals. The available forages are poor in quality, being deficient in available energy, protein and minerals. To compensate for the low productivity of the livestock, farmers maintain a large herd of animals, which adds to the pressure on land and fodder resources. Due to ever-increasing population pressure of human beings, arable land is mainly used for food and cash crops, thus there is little chance of having good-quality arable land available for fodder production, unless milk production becomes remunerative to the farmer as compared to other crops. To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry crop residues and feed has to be met from either increasing productivity, utilizing untapped feed resources, increasing land area (not possible due to human pressure for food crops) or through imports.

The regional deficits are more important than the national deficit, especially for fodder, which is not economical to transport over long distances. The pattern of deficit varies in different parts of the country. For instance, the green fodder availability in Western Himalayan, Upper Gangetic Plains and Eastern Plateau and Hilly Zones is more than 60 per cent of the actual requirement. In Trans Gangetic Plains, the feed availability is between 40 and 60 per cent of the requirement and in the remaining zones, the figure is below 40 per cent. In case of dry fodder, availability is over 60 per cent in the Eastern Himalayan, Middle Gangetic Plains, Upper Gangetic Plains, East Coast Plains and Hilly Zones. In Trans Gangetic Plains, Eastern Plateau and Hills and Central Plateau and Hills, the availability is in

the range of 40-60 per cent, while in the remaining zones of the country the availability is below 40 per cent.

I.2: Details of Major Livestock Population in the State

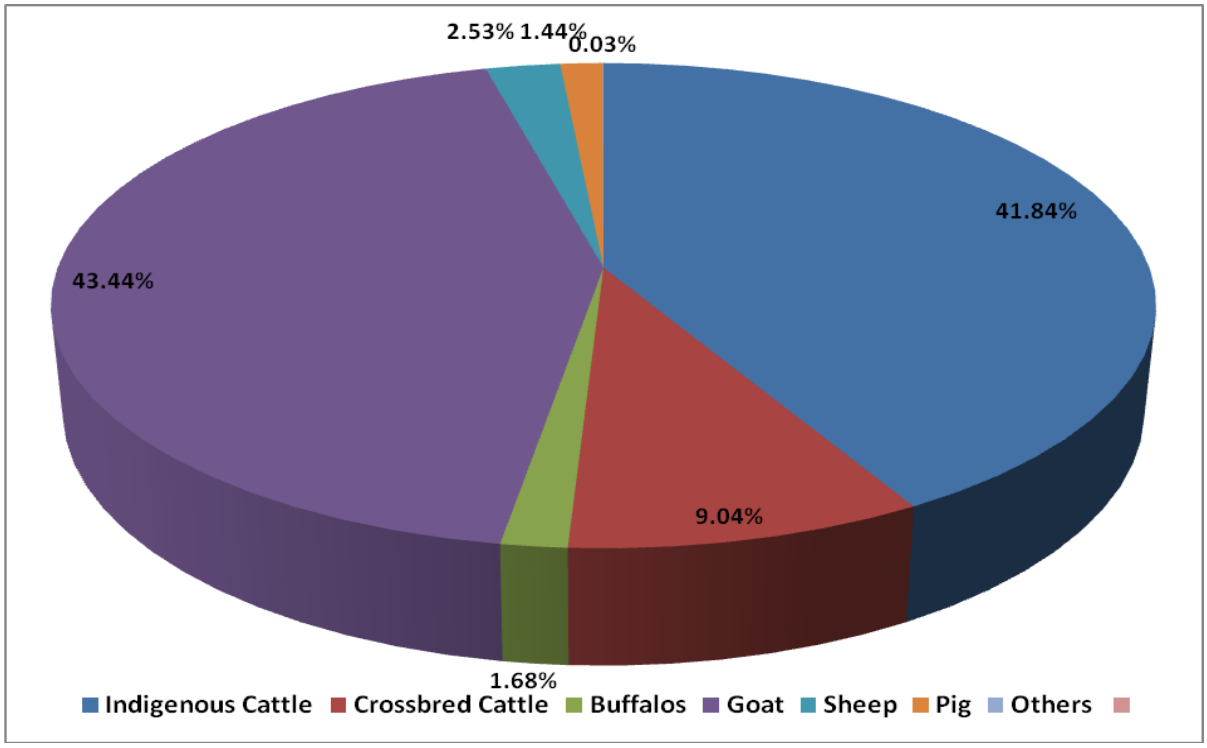
One of the pillars of the state's rural economy is the animal husbandry sector. It contributes about 3.89 per cent of the state domestic product and nearly 20.34 per cent of the state's total agricultural production. The gross value of output from livestock sector at current prices is about 329.4 billion rupees. The state is rich with 19.08 million cattle population which is 3rd in the country; 16.28 million goat population which is 2nd in India, and about 77.32 million poultry population which is 5th in India (Table 1.1). There are nearly 220 bovines and 200 small ruminants for every 1000 human populations in the State. Within bovine, cattle population in the state is predominant constituting 96.50 percent and buffaloes only 4.5 percent of total bovine population.

Within livestock, cattle and goat together constitutes more than 85 per cent of total livestock population in the state. While cattle accounted for 50.92 per cent (56.39 per cent at national level) of total livestock in the state, goat accounted for 43.44 per cent against the national average of 27.80 per cent only. The corresponding share of other species in the total livestock population during 2019 are 2.53 per cent sheep, 1.68 per cent buffalo, 1.44 per cent pig and only 0.03 per cent others like horse, donkey, mithun, mule, yak, etc (Fig 1.1).

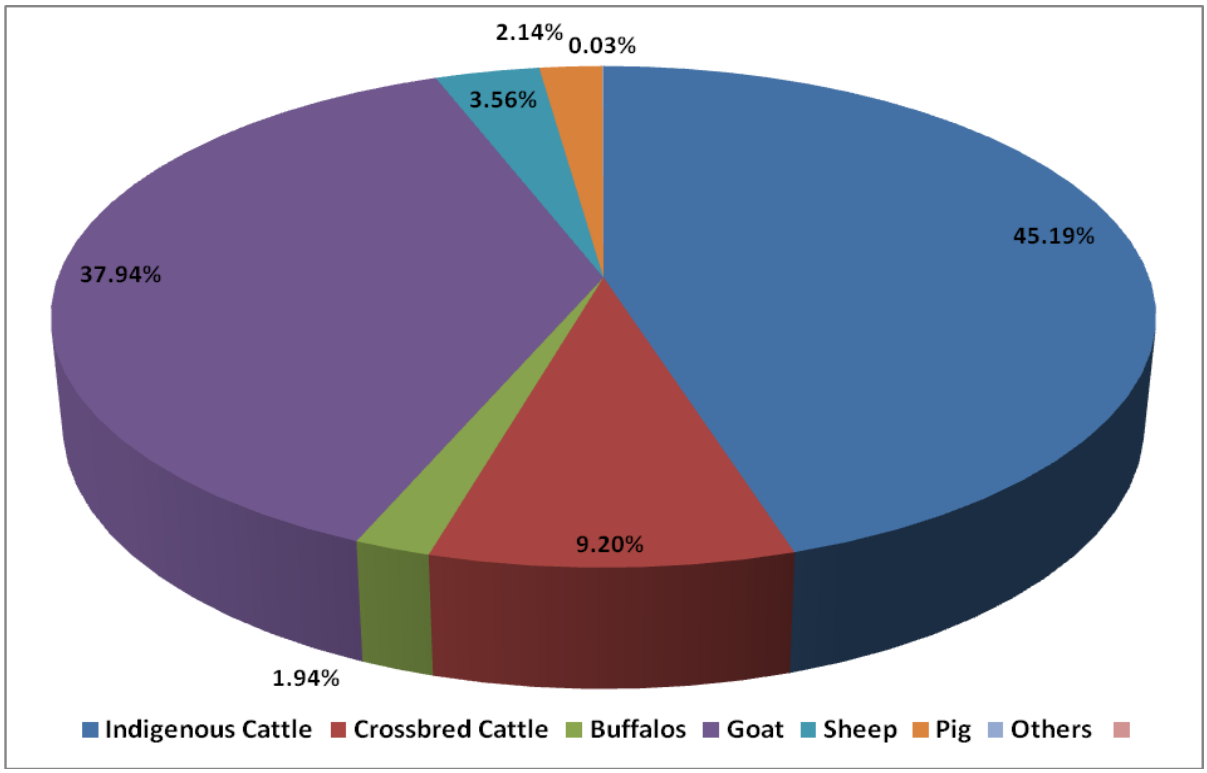
Although, the state of West Bengal has fourth largest number of livestock in the country, most of them are indigenous (82.46 per cent) in nature which is one of the important constraints to boost up the productivity. Due to physical and socio-economic constraints the percentage of cross-breed livestock population is low in West Bengal. The percentage of cross-breed cattle population is particularly low in Red Laterite Region (Purulia, Birbhum, and Bankura); in Terai- Teesta Alluvial and Gangetic Alluvial Regions (Dakshin Dinajpur and Uttar Dinajpur) and in Coastal region (South 24 Parganas district). These are the areas with highest concentration of poor peoples in West Bengal. Our field survey also reveals that, due to poverty, only few of the respondents are able to keep improved breed of livestock. Therefore, in contrast to national average, only 17.77 percent of cattle's are crossbred in West Bengal. Percentage of cross-breed cattle population is relatively higher in Gangetic Alluvial region (Murshidabad, Nadia, North 24 Parganas, Howrah, Hooghly, and in Burdwan).

However, over the years, the share of crossbred cattle has increased from a mere 5.25 per cent in 1997 to 17.77 percent in 2019 (Table 1.2).

Fig 1.1: Distribution of Major Livestock Population in West Bengal



2019



2012

Table 1.1: Growth in Major Components of the Livestock Sectors in the State

(Population in millions)

Sr. No.	Livestock	Population (2012)	Population (2019)	Growth (in %)
1	Total livestock	30.34	37.48	23.53
2	Total Bovine	17.11	19.71	15.20
3	Total Cattle	16.50	19.08	15.64
4	Total Indigenous Cattle	13.71	15.68	14.37
5	Total Crossbred Cattle	2.79	3.39	21.51
6	Total Buffalos	0.59	0.63	6.78
7	Total Goat	11.51	16.28	41.44
8	Total Sheep	1.08	0.95	-12.04
9	Total Pig	0.65	0.54	-16.92
10	Others (Horse, Donkey, Mule, Yak, etc)	0.01	0.01	-
11	Total Poultry	52.84	77.32	46.44

Source: *Key Statistics, 20th Livestock Census*; *Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India*

The state is the home of second highest number (16.28 million) of goats in the country, next to Rajasthan only. Goat rearing is very common in West Bengal where it is commonly known as the 'poor man's cow.' Goat rearing is very much profitable and has huge economic potentiality. Goats can efficiently survive on available shrubs and trees where availability of fodder is very poor. Therefore, goat rearing is considered as one of the best options in drought-prone areas particularly in red and laterite agro-climatic region of West Bengal (Purulia, Bankura and Birbhum). Because of low management problems, low initial investment, early sexual maturity (at the age of 10–12 months), short gestation period (in 16–17 months they start giving milk), goat rearing is very popular among the poor farmers of the state. Goat rearing is also less risky than the other livestock.

The prevailing socio-economic conditions of rural West Bengal (where more than 96 percent holding are in small and marginal category with average per capita land holding below 0.15 hectare), goat rearing is an important component of mixed farming. Goat can survive on little vegetation and can act as an insurance against crop failure and provides alternate source of income of 40 percent of the rural population particularly who are below the poverty line. This is why goat is generally known as poor man's cow (NPCS Board, 2012). However, goat rearing in West Bengal is mostly in small scale perhaps because of lack of sufficient green fodder and due to the fear of mortality (Kumar et al., 2003). The main breeds are Black Bengal, Jamunapari, Beetal, Bar Bari, Sirohi, Osmanabadi, Jhakarna and Sanganeri. More than 98 per cent of goat population in the state belongs to Black Bengal because of its tasty

meat, good quality skin and low rearing cost, although the productivity of Black Bengal goat is comparatively lower than the other breeds.

Poultry is another important livestock, growing very fast in the state. Besides fish and rosgolla, West Bengal has an insatiable appetite for goat meat, chicken and eggs. Therefore, both goat and poultry farming represents a golden opportunity for off-farm livelihood diversification for unemployed youths in the state. However, sheep rearing is not very common in West Bengal and are being reared in very few pockets only where it still continues to be a nomadic/backward proposition of small, marginal and landless people.

I.3: Growth Pattern of Major Livestock Population and Livestock Products

A summary of livestock population in the state is given in Table 1.1 and 1.2. As per the 20th Livestock Census 2019, West Bengal had a total bovine population of 19.71 million, up by 15.20 per cent than previous census of 2012. The highest growth is observed in case of Poultry population (46.44 per cent) from 52.84 million in 19th census period to 77.32 million in 20th census period (Table 1.1) followed by goat population (41.44 per cent) from 11.51 million in 2012 to 16.28 million in 2019. Interestingly, there is a 16.92 percent decline in total number of pigs and 12.04 per cent decline in sheep population over the previous census (Table 1.1). The growth of cattle population is moderate (15.64 per cent) relative to poultry and goat, but very high when compared with national average of only 0.83 per cent growth in cattle population during the same time period. Further, as compared to only 4.63 per cent increase in the total livestock population in the country, there has been 23.53 per cent increase in the total livestock population in the state between 2012 and 2019. The share of buffalo population was decreased from 1.94 per in 2012 to 1.68 per cent in 2019. Over the years, buffalo population in continuously declining both in absolute numbers as well as in terms of percentage (Table 1.2). The total number of buffalo in the state has nearly halved during lass 22 years may be due to unavailability of adequate fodder and high rearing costs.

Looking into the summary of the livestock population in the state, it is encouraging that crossbred cattle have been increased by 21.33 per cent between 2012 and 2019 and total female crossbred population has been increased by a whopping 33.74 per cent during the period of consultation. However, if we look into the growth pattern in different species of livestock since the last five census period, the results are somehow mixed in nature (Fig 1.2). The growth in indigenous cattle and goat were erratic and total bovine population remained

more or less stagnant (with an annual decrease of 0.06 per cent during the last five census period). However, negative growth has been observed in case of buffalo, sheep, pig, and other minor livestock.

Table 1.2: Summary of Livestock Population in West Bengal (1997-2019)

(Population in numbers)

Livestock Population	Livestock Census				
	1997	**2003**	**2007**	**2012**	**2019**
Total Bovine	**1,90,64,830**	**1,99,99,451**	**1,99,52,035**	**1,71,11,618**	**1,97,09,078**
Total Cattle	**1,78,31,729**	**1,89,13,219**	**1,91,88,269**	**1,65,14,239**	**1,90,77,916**
Total Exotic/ Crossbred cows	***9,36,359***	***11,18,969***	***26,42,144***	***27,96,419***	**33,93,152**
Total Females	7,74,868	8,96,901	20,83,526	22,56,228	30,17,450
Under 1 year	1,62,369	1,81,772	4,50,419	4,96,268	8,25,099
1 to 2.5 year	1,49,973	1,64,023	4,63,670	4,90,104	6,51,029
In-milk	2,96,753	3,53,120	7,40,816	7,31,138	10,43,096
Dry	1,14,447	1,36,035	3,14,172	3,70,391	3,33,358
Milch	4,11,200	4,89,155	10,54,988	11,01,529	13,76,454
Not even calved once	51,326	61,951	97,135	1,56,219	1,19,140
Others	NA	NA	17,314	12,108	45,728
Total Males	1,61,491	2,22,068	5,58,618	5,40,191	3,75,702
Total Indigenous cows	***1,68,95,370***	***1,77,94,250***	***1,65,46,125***	***1,37,17,820***	**1,56,84,764**
Total Females	91,33,740	98,49,403	1,01,13,893	89,32,417	1,19,40,992
Under 1 year	16,62,283	16,99,628	18,36,436	18,65,718	32,33,170
1 to 3 years	20,68,650	22,18,264	25,64,159	20,13,971	29,76,563
In-milk	27,40,176	30,52,648	28,59,968	25,55,590	35,67,120
Dry	20,58,850	22,40,115	21,44,153	17,30,380	14,95,776
Milch	47,99,026	52,92,763	50,04,121	42,85,970	50,62,896
Not even calved once	6,03,781	6,38,748	5,80,916	7,06,165	4,77,127
Others	NA	NA	1,28,261	60,593	1,91,236
Total Males	77,61,630	79,44,847	64,32,232	47,85,403	37,43,772
Total Buffaloes	***12,33,101***	***10,86,232***	***7,63,766***	***5,97,379***	**6,30,921**
Total Females	5,79,483	3,92,914	2,66,576	2,54,320	3,15,114
Under 1 year	53,652	64,403	42,659	45,718	63,994
1 to 3 years	50,290	57,960	37,843	36,979	57,977
In-milk	1,41,231	1,69,895	1,33,338	1,16,926	1,41,581
Dry	66,244	76,815	40,854	39,065	32,883
Milch	2,07,475	2,46,710	1,74,192	1,55,991	1,74,464
Not even calved once	20,255	23,841	8,964	14,616	12,881
Others	NA	NA	2,918	1,016	5,798
Total Males	6,53,618	6,93,318	4,97,190	3,43,059	3,15,807

Source: 16th, 17th, 18th 19th and 20th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Fig 1.2: Growth in Major Components of the Livestock Sectors in West Bengal

(Population in numbers)

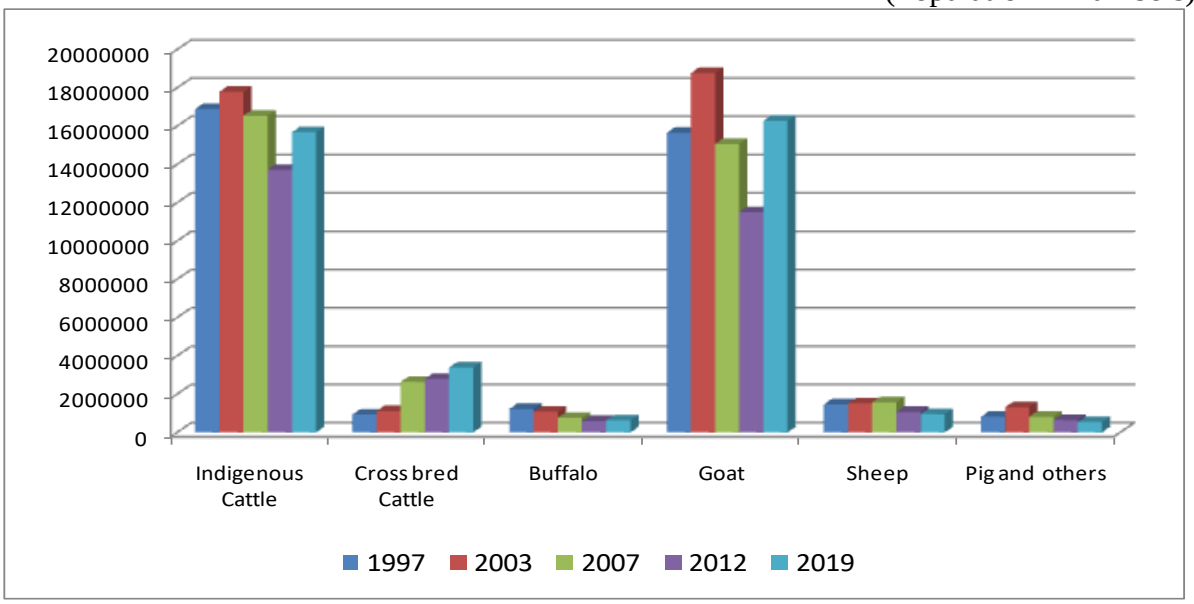
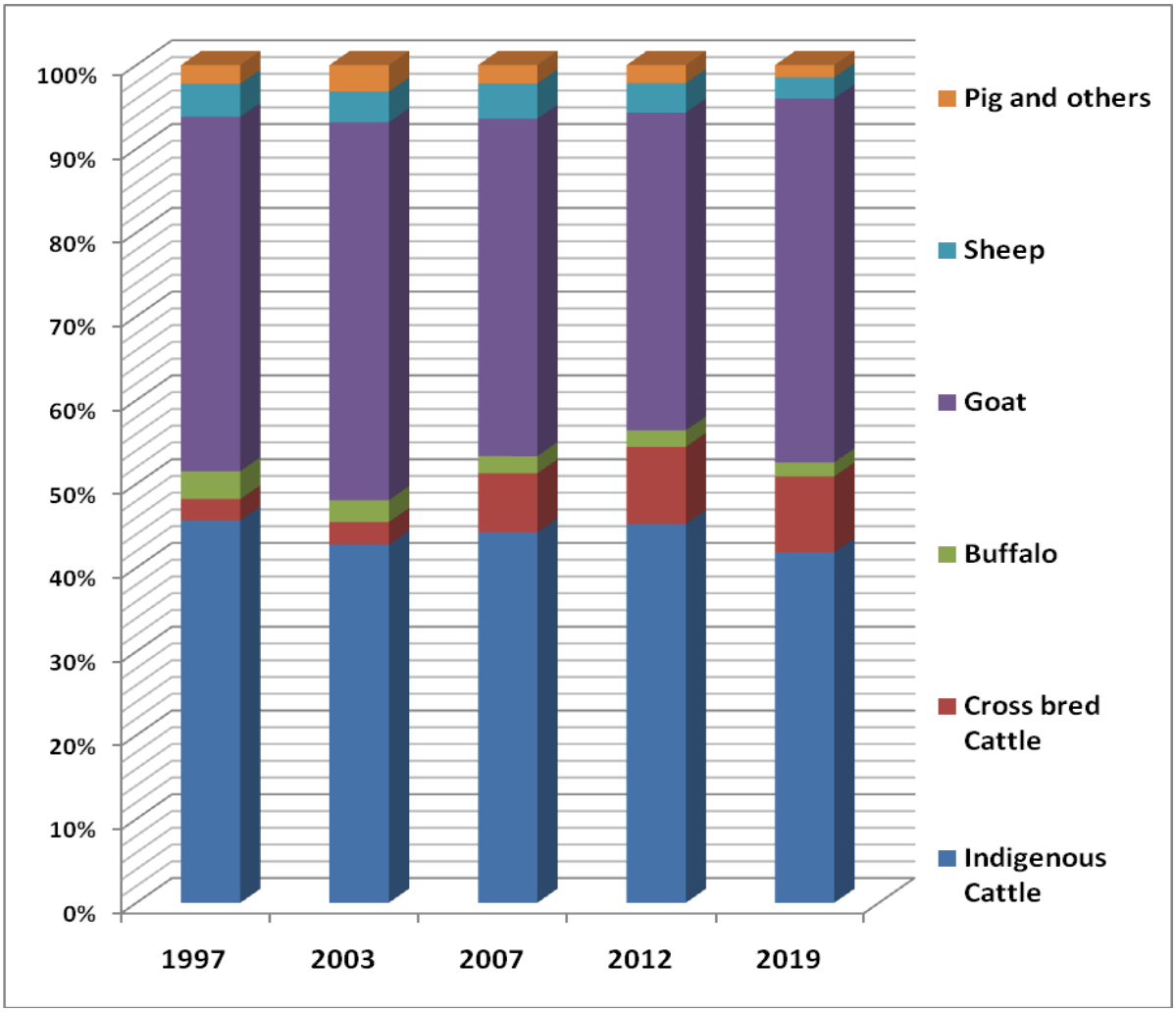


Fig 1.3: Changes in Composition of Major Livestock Population in West Bengal (%)



So far as changes in the composition of livestock population is concerned, indigenous cattle and goat continues to dominate the livestock sector in West Bengal during all the census period (Fig 1.3). Though their relative share has been declined marginally, still, together they constitute as high as 85.28 per cent of total livestock population in the state in 2019 (the corresponding figure was 87.96 per cent in 1997). In contrast, the relative share of cross bred cattle in the total livestock population has increased by more than threefold from a mere 2.53 per cent in 1997 to 9.04 per cent in 2019. However, both the total number as well as relative share of buffalo, sheep and pig showed a declining trend during last five censuses.

A further look into the district level figures reveals that in almost all the districts there has been a surge in the crossbred cattle population (Table 1.3 to 1.5). Of which, the growth in South 24 Parganas (48 per cent), Coochbehar (68 per cent), Howrah (57 per cent), Birbhum (38 per cent), Bankura (68 per cent) are higher compared to the other districts. Very few districts like Kolkata, Paschim Medinipur and Murshidabad witnessed a negative growth during the same period (Table 1.3). In case of indigenous cattle, the results were kind of a mixed bag as districts like Uttar Dinajpur (49 per cent), Murshidabad (47 per cent), Malda (40 per cent), Coochbehar (37 per cent) and Birbhum (23 per cent) witnessed a positive growth in population since the last census whereas, districts like Hoogly, Howrah, Paschim Medinipur, Kolkata has witnessed a decrease in the population. A strong positive growth in case of buffalo population were observed in the districts of south 24 Parganas (101 per cent), Coochbehar (68 per cent), Birbhum (63 per cent) whereas, districts like Purba Medinipur, Kolkata, Dakshin Dinajpur etc., has witnessed a fall in total buffalo population. Overall, the population increase was in the order of 21 per cent (Crossbred cattle) followed by 14 per cent (Indigenous cattle) and 5 per cent (Buffalo) (Table 1.3).

Table 1.3: District wise Total Bovine Population in West Bengal (1997-2019)

(Population in '000)

State &Districts	Indigenous Cattle					Crossbred Cattle					Buffalo				
	Livestock Census					Livestock Census					Livestock Census				
	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019
WEST BENGAL	**16,895.40**	**17,794.30**	**16,546.10**	**13,717.80**	**15,684.76**	**936.40**	**1,119.00**	**2,642.1**	**2,796.40**	**3,393.15**	**1,233.10**	**1,086.20**	**763.80**	**597.40**	**630.92**
Bankura	1,307.90	1,300.60	1,445.70	1,217.90	1,245.27	27.40	33.90	105.80	147.00	246.56	169.80	141.80	98.70	66.70	64.43
Paschim Barddhaman	1,584.40	1,649.30	1,487.10	1,161.60	228.51	67.80	79.70	243.70	272.30	45.13	168.90	129.50	120.40	98.20	22.68
Purba Barddhaman					1,141.75					390.92					58.94
Birbhum	1,008.00	1,019.90	1,052.40	870.90	1,071.90	16.40	25.00	81.00	83.60	113.44	68.20	60.80	67.60	58.10	94.94
Dakshin Dinajpur	461.10	451.30	557.80	482.80	508.41	6.20	9.30	16.30	20.10	23.65	31.80	26.50	20.00	7.00	1.92
Kalimpong	141.60	134.10	203.50	118.10	1.63	97.80	77.00	85.00	107.60	47.29	13.40	12.50	6.40	2.90	0.13
Darjeeling					137.61					66.27					6.99
Howrah	441.30	439.30	292.70	402.20	164.59	20.60	27.50	46.60	39.30	61.80	23.70	13.70	10.60	4.20	5.72
Hooghly	922.70	941.00	729.50	734.30	650.53	125.20	131.40	231.30	221.90	262.22	50.70	33.80	31.30	23.90	35.23
Jalpaiguri	775.90	895.30	921.60	847.20	670.06	29.00	35.60	94.40	103.60	57.53	19.30	14.80	11.50	8.80	5.38
Alipurduar					481.67					38.77					2.21
Cooch Behar	988.50	899.90	981.50	810.10	1,115.09	22.20	29.30	69.40	66.10	111.58	15.60	11.60	4.40	3.80	6.40
Kolkata	11.20	10.50	2.40	2.00	0.65	5.20	3.80	1.90	2.60	0.36	5.20	2.70	2.90	1.40	0.46
Malda	623.10	607.80	665.20	655.20	917.50	16.60	53.90	66.40	99.90	121.27	71.50	58.10	50.80	39.00	38.44
Murshidabad	947.30	1,070.30	829.30	552.30	813.27	69.90	107.10	501.90	399.00	386.55	125.60	195.50	75.30	54.90	66.78
Nadia	808.50	847.90	522.30	424.00	451.70	194.60	193.20	348.80	325.00	365.08	85.90	66.10	24.10	17.80	17.16
North 24 Parganas	1,090.10	1,204.90	635.30	416.50	461.32	147.80	150.90	312.90	233.40	236.28	66.70	40.10	38.10	33.20	34.44
Paschim Medinipur	3,122.20	1,931.70	2,151.40	1,895.80	1,378.81	54.00	62.30	236.50	406.70	379.63	-	53.40	67.20	72.10	37.65
Purba Medinipur		1,461.20	1,312.80	893.50	873.47		28.80	93.50	133.80	220.03		3.80	0.80	7.70	0.26
Jhargram	850.80	889.10	927.80	822.60	522.22	6.70	8.00	16.40	13.50	41.27	181.40	157.30	100.60	75.10	29.02
Purulia					897.20					18.08					77.65
South 24 Parganas	1,160.70	1,289.00	1,052.00	725.70	927.89	22.10	29.80	51.30	61.60	91.61	33.50	26.90	11.90	5.80	11.71
Uttar Dinajpur	650.30	750.90	775.90	685.20	1,023.74	6.90	32.50	39.00	59.50	67.85	31.70	37.20	21.40	16.90	12.38

Source: 16th, 17th, 18th 19th and 20th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 1.4: District wise Total Female Bovine Population in West Bengal (1997-2019)

(Population in '000)

State &Districts	Indigenous Cattle					Crossbred Cattle					Buffalo				
	Livestock Census					Livestock Census					Livestock Census				
	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019
WEST BENGAL	**9133.70**	**9849.40**	**10113.90**	**8932.40**	**11940.99**	**774.90**	**896.90**	**2083.50**	**2256.20**	**3017.45**	**579.50**	**392.90**	**266.60**	**254.30**	**315.11**
Bankura	701.40	706.40	814.10	742.10	840.91	22.30	27.10	79.60	117.00	214.96	60.70	42.40	24.60	19.80	21.25
Paschim Barddhaman	983.40	1052.20	1,19.6	865.50	184.78	53.00	60.10	195.20	222.70	41.50	91.40	53.70	52.50	57.10	17.34
Purba Barddhaman					974.65					356.54					36.90
Birbhum	478.90	529.70	507.70	481.50	741.83	11.20	17.20	59.80	65.60	102.92	18.60	13.40	15.50	14.90	39.01
Dakshin Dinajpur	198.30	220.00	306.40	299.40	388.71	5.00	6.90	13.40	17.20	21.19	7.90	4.40	0.20	0.20	0.30
Kalimpong	79.20	70.90	127.00	75.00	1.39	72.10	54.80	64.60	77.90	36.89	8.40	6.90	4.40	1.90	0.09
Darjeeling					114.93					50.54					2.51
Howrah	320.60	310.00	245.40	373.20	150.69	16.70	22.20	39.60	33.90	57.39	22.70	12.70	10.40	3.90	5.57
Hooghly	606.60	633.10	537.90	379.60	501.09	107.80	111.70	185.40	188.60	239.71	39.70	23.40	21.90	15.60	27.71
Jalpaiguri	423.10	463.30	520.10	533.00	407.01	24.00	28.80	72.70	84.30	37.35	11.20	6.80	7.50	5.80	1.64
Alipurduar					505.63					50.73					3.63
Cooch Behar	514.60	482.20	535.00	494.40	919.06	18.00	23.20	56.00	53.20	103.24	8.80	5.20	1.80	1.40	3.66
Kolkata	10.10	9.50	1.80	1.70	0.47	4.70	3.50	1.80	2.30	0.34	4.80	2.40	2.60	1.30	0.44
Malda	287.00	358.90	391.80	419.30	702.12	14.50	44.80	54.80	81.70	102.71	27.10	14.30	11.30	14.30	21.29
Murshidabad	495.40	540.80	482.60	352.60	604.02	56.10	82.10	383.20	318.10	337.25	58.80	70.20	24.90	24.60	37.99
Nadia	424.10	444.90	349.20	300.80	366.61	166.60	162.30	277.00	258.80	322.89	45.50	29.40	5.70	5.60	8.21
North 24 Parganas	720.60	777.90	426.60	294.70	344.77	130.40	124.30	261.80	185.20	207.94	58.60	33.10	35.50	31.30	32.67
Paschim Medinipur	1677.30	1040.30	1290.90	1260.40	1092.04	42.60	49.00	182.00	325.80	341.04	33.00	20.00	17.40	23.30	15.23
Purba Medinipur		797.70	1033.60	733.20	789.20		22.60	74.20	113.70	202.82		1.40	0.50	3.10	0.22
Jhargram	350.50	373.20	363.70	345.00	334.19	4.90	5.20	11.20	9.90	34.60	48.40	27.40	17.40	18.10	7.38
Purulia					395.60					14.91					13.87
South 24 Parganas	584.00	627.60	732.90	545.30	770.11	18.90	23.80	38.70	50.30	77.12	20.60	13.70	7.10	4.30	10.15
Uttar Dinajpur	278.80	411.00	427.50	435.70	811.18	5.90	27.30	32.60	50.00	62.90	13.20	12.30	5.40	7.80	8.06

Source: 16th, 17th, 18th 19th and 20th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 1.5: District wise Total Male Bovine Population in West Bengal (1997-2019)

(Population in '000)

State &Districts	Indigenous Cattle					Crossbred Cattle					Buffalo				
	Livestock Census					Livestock Census					Livestock Census				
	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019	1997	2003	2007	2012	2019
WEST BENGAL	**7,761.60**	**7,944.80**	**6,432.20**	**4,785.40**	**3,743.77**	**161.50**	**222.10**	**558.60**	**540.20**	**375.70**	**653.60**	**693.30**	**497.20**	**343.10**	**315.81**
Bankura	606.50	594.30	631.60	475.80	404.36	5.00	6.80	26.20	30.10	31.61	109.10	99.40	74.10	46.90	43.17
Paschim Barddhaman	601.00	597.10	467.50	296.10	43.73	14.90	19.60	48.50	49.60	3.63	77.40	75.80	67.80	41.10	5.34
Bardhaman					167.10					34.38					22.04
Birbhum	529.00	490.30	544.70	389.40	330.07	5.20	7.70	21.20	18.00	10.52	49.60	47.50	52.10	43.20	55.93
Dakshin Dinajpur	262.80	231.30	251.30	183.40	119.70	1.20	2.40	2.90	2.80	2.46	23.90	22.10	19.80	6.80	1.62
Kalimpong	62.40	63.20	76.40	43.10	0.24	25.70	22.20	20.40	29.80	10.40	5.00	5.60	2.00	1.00	0.04
Darjeeling					22.68					15.73					4.49
Howrah	120.70	129.30	47.30	29.00	13.90	3.90	5.30	7.10	5.40	4.41	1.00	1.00	0.30	0.20	0.16
Hooghly	316.10	308.00	191.60	354.60	149.44	17.40	19.80	45.90	33.20	22.51	11.00	10.40	9.40	8.40	7.52
Alipurduar	352.80	432.00	401.50	314.20	74.66	5.00	6.80	21.70	19.30	1.43	8.20	8.10	3.90	3.10	0.57
Jalpaiguri					164.43					6.81					1.75
Cooch Behar	473.90	417.70	446.40	315.70	196.03	4.20	6.10	13.50	12.90	8.34	6.80	6.40	2.60	2.40	2.74
Kolkata	1.20	1.00	0.60	0.30	0.18	0.50	0.20	0.10	0.30	0.01	0.40	0.30	0.20	0.10	0.02
Malda	336.20	248.90	273.40	235.80	215.38	2.10	9.10	11.60	18.20	18.56	44.30	43.80	39.60	24.70	17.15
Murshidabad	451.90	529.50	346.60	199.70	209.25	13.70	25.00	118.70	80.80	49.30	66.80	125.40	50.40	30.30	28.79
Nadia	384.40	403.00	173.00	123.20	85.10	28.00	30.90	71.70	66.20	42.19	40.40	36.70	18.30	12.20	8.95
North 24 Parganas	369.50	427.00	208.80	121.90	116.55	17.40	26.60	51.20	48.20	28.33	8.10	7.00	2.60	1.80	1.78
Paschim Medinipur	1,444.90	891.40	860.50	635.40	286.77	11.30	13.30	54.50	80.90	38.60	37.10	33.40	49.70	48.80	22.42
Purba Medinipur		663.50	279.20	160.30	84.26		6.10	19.30	20.10	17.21		2.40	0.30	4.60	0.05
Jhargram	500.30	516.00	564.10	477.70	188.03	1.80	2.80	5.20	3.60	6.67	133.00	129.90	83.20	57.00	21.64
Purulia					501.60					3.17					63.78
South 24 Parganas	576.70	661.30	319.10	180.40	157.78	3.20	6.00	12.60	11.30	14.49	12.90	13.20	4.80	1.50	1.56
Uttar Dinajpur	371.50	340.00	348.50	249.40	212.56	1.00	5.30	6.40	9.50	4.95	18.50	24.90	15.90	9.00	4.32

Source: 16th, 17th, 18th 19th and 20th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 1.6: District wise Small Ruminants Population in West Bengal (2019)

(Figures in actual numbers)

State and Districts	GOAT			PIG			Sheep		
	Male	Female	Total	Exotic	Indigenous	Total	Exotic	Indigenous	Total
West Bengal	**55,79,756**	**1,06,99,584**	**1,62,79,340**	**31,233**	**5,09,123**	**5,40,356**	**16,088**	**9,36,798**	**9,52,856**
24 Paraganas North	2,94,293	4,85,708	7,80,001	1,034	6,207	7,241	300	34,056	34,356
24 Paraganas South	2,00,735	5,90,852	7,91,587	1,981	5,367	7,348	250	82,008	82,258
Alipurduar	65,041	2,16,723	2,81,764	1,518	57,473	58,991	53	7,423	7,476
Bankura	3,60,653	7,03,815	10,64,468	68	20,580	20,648	330	71,559	71,889
Bardhaman	4,61,959	9,09,026	13,70,985	378	20,949	21,327	3,274	1,32,691	1,35,965
Birbhum	3,73,860	7,94,936	11,68,796	229	38,145	38,374	209	1,58,997	1,59,206
Coochbehar	1,00,807	3,86,167	4,86,974	1,082	6,290	7,372	728	63,096	63,824
Darjeeling	68,132	96,702	1,64,834	8,968	48,198	57,166	351	618	969
Dinajpur Dakshin	2,55,522	3,42,615	5,98,137	767	40,288	41,055	167	6,128	6,295
Dinajpur Uttar	3,34,228	5,51,054	8,85,282	235	25,574	25,809	36	1,485	1,521
Hooghly	2,59,991	6,26,419	8,86,410	630	16,041	16,671	120	1,535	1,655
Howrah	36,730	1,20,287	1,57,017	111	251	362	2	235	237
Jalpaiguri	1,64,031	3,48,291	5,12,322	104	36,576	36,680	58	8,111	8,169
Jhargram	1,82,904	2,57,100	4,40,004	520	28,647	29,167	115	52,230	52,345
KALIMPONG	28,898	35,211	64,109	9,953	3,255	13,208	80	2	82
Kolkata	2,982	643	3,625	23	312	335	0	93	93
Maldah	4,97,148	8,79,339	13,76,487	483	70,486	70,969	616	32,303	32,919
Medinipur East	1,16,279	3,58,951	4,75,230	279	1,612	1,891	77	5,871	5,948
Medinipur West	3,03,418	5,69,451	8,72,869	579	24,859	25,438	268	17,904	18,172
Murshidabad	6,30,076	11,21,200	17,51,276	215	8,021	8,236	3,723	47,692	51,415
Nadia	3,44,596	5,79,743	9,24,339	1,577	3,346	4,923	3,293	21,376	24,669
PASCHIM BARDHAMAN	77,156	1,78,987	2,56,143	259	16,376	16,635	20	6,478	6,498
Purulia	4,20,317	5,46,364	9,66,681	240	30,270	30,510	2,018	1,84,907	1,86,925

Source: 20th Livestock Census, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 1.7: Growth in Major Livestock Products in West Bengal

Items	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Growth Rate % (CAGR)
Milk Production (in thousand tonnes)							
All India	137685	146314	155491	165404	176347	187749	4.80
West Bengal	4906	4961	5038	5183	5389	5607	2.77
% Share of West Bengal	3.56	3.39	3.24	3.13	3.06	2.99	-
Meat Production (in thousand tonnes)							
All India	6235	6691	7020	7386	7656	8114	5.19
West Bengal	649	657	686	706	773	831	5.13
% Share of West Bengal	10.41	9.82	9.78	9.56	10.09	10.24	-
Wool Production (in thousand kgs)							
All India	47909	48140	43581	43544	41463	40420	-3.64
West Bengal	725	740	748	753	758	760	0.90
% Share of West Bengal	1.51	1.54	1.72	1.73	1.83	1.88	-
Egg Production (in million numbers)							
All India	74752	78484	82928	88137	95217	103318	6.67
West Bengal	4746	4814	6011	6554	7643	8600	13.54
% Share of West Bengal	6.35	6.13	7.25	7.44	8.03	8.32	-

Source: Agricultural Statistics at a Glance (various issues), Ministry of Agriculture and Farmers Welfare, Govt. of India.

Table 1.7 shows the trend in milk, meat, wool and egg production in West Bengal as well as in India in recent years. Besides fish and sweet, West Bengal has an insatiable demand for egg, meat and chicken but not for milk. With around 3 per cent share, the state ranks 12th in milk production in the country. Total milk production in West Bengal is only 5607 thousand tonnes during 2018-19 with an annual growth rate of just 2.77 per cent. The milk production in West Bengal mainly consists of cow and buffalo milk. Wool production in West Bengal is more or less stagnant as compared to a negative growth in the country. Induced by growing demand for meat and egg, poultry sector is growing very fast in the state. Production of egg is growing at an annual rate of 13.54 per cent per annum. The growth rate in meat production is also more than 5 per cent per annum.

I.4: Status of the Availability and Requirement of Feed and Fodder in West Bengal

West Bengal is a severely feed and fodder deficient state in India and there exists a considerable gap between supply and demand particularly during the period of drought and flood. The nutritional status of the livestock and their productivity mostly depends on the amount and type of feed fed. Livestock feeds are classified as roughages and concentrates, the former being further classified into green fodder and dry fodder. Most of the feed comes from agricultural residues. While paddy straw constitutes 94 per cent of the total agricultural residue, it is also used for fuel, thatching and paper manufacturing. Throughout the state crop residue (Paddy straw) is the main dry fodder available for feeding livestock. The requirement of both dry fodder as well as green fodder is expected to increase substantially over the years due to increase of livestock population. The cattle and buffaloes are normally fed on the fodder available from cultivated areas, supplemented to a small extent by harvested grasses and top feeds. Grazing and harvested grasses are the chief fodder source for small ruminants like goat and sheep in addition to top feeds, either browsed or lopped from shrubs and trees.

I.4.1: Area under Fodder Crops

Authentic data on fodder cultivation is not available for West Bengal. There are conflicting statistics so far as area under fodder crop in the state is concerned. According to *Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare, Government of India,* the area under fodder crop in West Bengal is only 3.5 thousand hectares which is less than 0.04 per cent of gross sown area in the state (Table 1.10). The same data is reported by National Dairy Development Board (NDDB, 2017) as well as in other important data base like www.indiastat.com. However, a close perusal of Table 1.11 reveals that the area under fodder crop is available only for few districts thus the state total of 3.5 thousand hectares is not a comprehensive figure. In contrast to this, according to Directorate of Animal Resources and Animal Husbandry, Government of West Bengal, a total area of 139.87 thousand hectare is covered for growing fodder in the state with a total green fodder production of 110.76 lakh metric tonnes which is 1.18 per cent of gross sown area in the state (Jana et al, 2019). According to www.indiastat.com the area under permanent pastures & other grazing land in the state is as low as only 2000 hectares. Therefore, it is pertinent to note here that comprehensive and time series data on area under fodder crop in West Bengal is not available and thus caution should be taken while using such data in future. However, one thing is clear that West Bengal is an acute fodder

deficient state. It is partly due to non-availability of fodder land which is below all India average and lack of adequate pasture and grazing land.

A vast tract of Southern West Bengal, like districts of Purulia, Birbhum, Bankura, Bardhaman, and Paschim Medinipur are in Red Lateritic Agro-Climatic Region where the average temperature in summer goes more than 40°C. This reduces productive and reproductive capacity of the livestock population. Due to proneness to drought, availability of pasture and grazing land are comparatively very low, in this region. Availability of fodder crops is also poor here because of unfertile soil, low and erratic rainfall and very poor irrigation facility. The northern hilly region is suffering from soil erosion and heavy rainfall during rainy seasons and comes under the grip of intense cold during winter, which makes moving and grazing of livestock difficult. In this region too, availability of fodder crops are very low due to steep slope, bare hard rocks, acidic soil, heavy rainfall and soil erosion. There is huge water scarcity in the dry seasons which not only affect the drinking water resources but also reduces the productivity and reproductive capacity of livestock population. In coastal regions too, availability of fodder (both dry and green) are also very low as per requirement to feed the livestock population.

In order to augment fodder cultivation, the state is implementing Centrally Sponsored Fodder and Feed Development Scheme and a "Regional Station for Forage Production and Demonstration" is operational at Nadia. Additionally, farmers are also provided fodder mini-kits with central funding. There are 15 important fodder farms in West Bengal, namely- (a) Haringhata Farm (Main & North), (b) Kalyani Farm, Naiad, (c) Fulia Fodder Farm, Nadia, (d)Salboni Fodder Farm -1 & 2, Paschim Medinipur, (e) Beldanga Fodder Farm, Murshidabad, (f) Kotalpur Fodder Farm, Bankura, (g) Ranjitpur Farm, Bankura, (h) Lokepur Farm, Bankura, (i) Baligori Fodder Farm, Hooghly, (j) Katwa Fodder Farm, Bardhaman, (k) Rasulpur, Fodder Farm, Bardhaman, (l) Jhatiakhali Farm, Jalpaiguri, Pedong Fodder Farm, Darjeeling, and n) Dungra Fodder Farm, Darjeeling.

I.4.2: Status of Feed Resources

The availability of feed and fodder remains a major area of concern; there is a gap between its demand and supply in the country. According to Indian Grassland and Fodder Research Institute (IGFRI) there is and will continue to be a huge deficit in both green and dry forage in the country (Table 1.8).

Table 1.8: Demand and Supply Estimates of Dry and Green Forages in India

(Million tonnes)

Year	Demand		Supply		Net deficit		% Deficit	
	Dry	**Green**	**Dry**	**Green**	**Dry**	**Green**	**Dry**	**Green**
2010	508.9	816.8	453.2	525.5	55.72	291.3	10.95	35.66
2020	530.5	851.3	467.6	590.4	62.85	260.9	11.85	30.65
2030	568.1	911.6	500.0	687.4	68.07	224.2	11.98	24.59
2040	594.9	954.8	524.4	761.7	70.57	193.0	11.86	20.22
2050	631.0	1012.7	547.7	826.0	83.27	186.6	13.20	18.43

Source: IGFRI Vision: 2050

As per the estimates of National Institute of Animal Nutrition and Physiology (NIANP), the deficit in the requirement and the availability of dry fodder, green fodder and concentrates in India during 2015 was to the extent of 21 per cent, 26 per cent, and 34 per cent, respectively. This is likely to increase to 23 per cent, 40 per cent, and 38 per cent, respectively, by 2025. The fodder deficit in India in terms of green fodder, dry fodder, and concentrates was 26 million tonnes (MT), 21 MT, and 34 MT in 2015, which is expected to reach 40 MT, 21 MT, and 38 MT by 2025, respectively. The NIANP in its reports on 'requirement' and 'availability' of fodder, 2012, had stated that "this shortage is due to increasing pressure on land for growing food grains, oilseeds and pulses and inadequate attention being given to the production of fodder crops. The critical issue currently faced by the Indian dairy sector is that since the NIANP's estimate, no report on fodder availability is compiled till date in the country. According to the parliamentary panel report (2016), fodder shortage is due to increasing pressure on land for growing food grains, oilseeds, pulses and inadequate attention being given to the production of fodder crops. While the number of livestock is growing rapidly, the grazing lands are gradually diminishing due to pressure on the land for agricultural and non-agricultural uses. Most of the grazing lands have either been degraded or encroached upon restricting its availability for grazing. The area under fodder cultivation is limited to about 1.2 per cent of the cropping area, and it has remained static for the last four decades.

Deficiency of green fodder in West Bengal is more than 99.6 per cent of requirements but there is surplus in dry fodder to the tune of 53.4 per cent. Present requirement of total fodder (Green and dry fodder) for cattle in West Bengal is 532.76 lakh MT per year and availability is only 237.02 lakh MT per year, resulting into a shortfall of more than 55 per cent.

Availability of feed ingredients is also bleak. According to an estimate (by Planning Commission, 2008-09), against the requirement of 25 thousand tonnes of concentrate, the availability was only 2.10 thousand tonnes. Deficiency percentage of cereal grain is 91.21, of oil-cakes 85.04, of pulse by-products 98.22 and of bran 81.96. There are certain reasons for huge feed-fodder deficiency in the state, namely; lower acreage under fodder crops (only 1.18 per cent cultivable land is used for fodder cultivation in the state against 4.6 per cent of national average); limited availability of pasture and grazing land (only 0.07 per cent of the total land is available for pasture and grazing lands), acute shortage in availability of fodder seed, and lack of awareness about fodder cultivation among the livestock farmers (Jana et al, 2019). So far as overall dry matter availability is concerned, there is huge deficit in the state (Table 1.9). There is a huge deficit in all the districts except the state capital Kolkata. The average deficit percentage is 42 per cent but it is particularly acute in the districts like Bankura, Darjeeling, Jalpaiguri, and North 24 Parganas to the extent of more than 60 per cent (Table 1.11).

Table 1.9: Overall Dry Matter Availability and Requirement in West Bengal

Year	Dry Matter ('000 MT)		
	Availability	Requirement	Surplus/Deficit
1997	17,049	40,462	-23,414
2003	27,519	46,308	-18,789
2007	29,344	45,855	-16,511
2008	30,025	46,437	-16,413
2009	30,025	47,347	-17,323
2010	28,165	48,627	-20,462
2011	26,719	50,327	-23,608

Source: Feedbase 2012, National Institute of Animal Nutrition and Physiology, Bangalore.

Table 1.10: Area under Fodder Crops and Gross Sown Area

Districts & State	Area under Fodder Crops ('000 ha)								Gross Sown area ('000 ha)							
	2000-01	2003-04	2007-08	2010-11	2011-12	2012-13	2013-14	2014-15	2000-01	2003-04	2007-08	2010-11	2011-12	2012-13	2013-14	2014-15
West Bengal*	**7.50**	**3.60**	**3.60**	**4.00**	**3.40**	**3.40**	**3.50**	**3.50**	**9,117**	**9,661**	**9,752**	**8,832**	**9,353**	**9,459**	**9,618**	**9,690**
Bankura	NA	NA	NA	0.10	NA	NA	0.10	0.10	499	441	566	322	504	504	509	492
Bardhaman	0.30	0.20	NA	0.00	NA	NA	NA	NA	789	865	832	748	772	776	797	780
Birbhum	0.20	0.30	0.30	0.40	0.70	0.70	0.70	0.70	459	517	561	421	556	539	557	556
Cooch Behar	NA	NA	0.10	0.10	0.10	0.10	0.10	0.10	508	484	547	512	513	515	517	534
Dakshin Dinajpur	NA	NA	NA	NA	NA	NA	NA	NA	299	308	322	313	305	303	305	308
Darjeeling	NA	NA	NA	NA	NA	NA	NA	NA	186	176	196	195	193	195	197	197
Hooghly	0.50	0.40	0.70	0.30	0.30	0.30	0.30	0.30	396	524	541	543	521	528	539	543
Howrah	NA	NA	NA	NA	NA	NA	NA	NA	165	190	163	160	157	157	155	167
Jalpaiguri	NA	NA	NA	NA	NA	NA	NA	NA	561	550	564	550	545	549	568	556
Malda	NA	NA	NA	NA	NA	NA	NA	NA	460	449	391	425	439	457	448	454
Murshidabad	0.30	2.50	1.50	2.50	1.20	1.20	1.20	1.20	755	972	976	867	892	915	923	947
Nadia	0.20	0.10	1.00	0.70	1.10	1.10	1.10	1.10	722	820	698	672	712	719	713	718
North 24 Parganas	6.00	NA	NA	0.10	NA	NA	NA	NA	514	482	520	453	464	460	470	483
Paschim Medinipur	NA	NA	NA	NA	NA	NA	NA	NA	774	914	939	878	913	956	996	1,009
Purba Medinipur	NA	NA	NA	NA	NA	NA	NA	NA	665	515	522	563	519	514	501	543
Purulia	NA	NA	NA	NA	NA	NA	NA	NA	325	357	385	218	336	356	376	351
South 24 Parganas	NA	NA	NA	NA	NA	NA	NA	NA	539	563	531	514	540	530	547	555
Uttar Dinajpur	NA	NA	NA	NA	NA	NA	NA	NA	501	533	497	480	471	484	499	496

*Note: * State level data is compiled based on district level available data only*

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

Table 1.11: District-wise Dry Matter (DM) Availability, Requirement and Balance

Districts	Available/ Required/ Balance	Dry Matter Availability, Requirement and Balance *('000 MT)*						
		1997	2003	2007	2008	2009	2010	2011
Bankura	Available	1,386.0	1,491.9	1,766.2	1,615.6	1,615.6	1,590.3	1,603.0
	Requirement	3,254.1	3,264.6	3,600.8	3,684.7	3,784.2	3,901.2	4,037.9
	Balance	-1,868.0	-1,772.7	-1,834.7	-2,069.1	-2,168.6	-2,310.9	-2,434.9
Bardhaman	Available	2,961.5	2,935.9	2,987.0	2,854.3	2,854.3	3,072.1	2,963.2
	Requirement	4,118.5	4,302.7	4,514.4	4,633.2	4,798.1	5,017.5	5,302.0
	Balance	-1,157.0	-1,366.9	-1,527.3	-1,778.9	-1,943.8	-1,945.4	-2,338.8
Birbhum	Available	1,893.8	1,843.2	1,944.4	1,975.9	1,975.9	1,646.7	1,811.3
	Requirement	2,329.1	2,479.4	2,607.4	2,658.8	2,729.2	2,821.9	2,941.0
	Balance	-435.3	-636.2	-662.9	-682.9	-753.3	-1,175.2	-1,129.7
Dakshin Dinajpur	Available	769.0	775.9	762.1	838.1	838.1	796.2	817.2
	Requirement	1,059.7	1,121.8	1,228.4	1,271.2	1,322.0	1,381.7	1,451.6
	Balance	-290.7	-345.9	-466.3	-433.1	-483.8	-585.5	-634.4
Darjeeling	Available	328.2	329.0	329.4	371.6	371.6	373.8	372.7
	Requirement	677.1	669.3	767.9	810.7	860.0	916.0	979.2
	Balance	-348.9	-340.3	-438.6	-439.1	-488.4	-542.3	-606.5
Howrah	Available	445.4	466.0	424.7	377.9	377.9	403.4	390.7
	Requirement	1,086.9	1,117.0	856.7	834.1	817.7	806.8	801.2
	Balance	-641.5	-651.0	-432.0	-456.2	-439.8	-403.4	-410.5
Hooghly	Available	1,335.0	1,281.8	1,388.1	1,459.0	1,459.0	1,425.4	1,442.2
	Requirement	2,634.0	2,753.0	2,514.9	2,524.3	2,553.5	2,603.0	2,673.9
	Balance	1,299.0	-1,471.2	-1,126.8	-1,065.4	-1,094.6	-1,177.6	-1,231.7
Jalpaiguri	Available	797.2	961.3	983.9	967.8	967.8	1,010.1	989.0
	Requirement	1,812.3	2,115.0	2,302.1	2,366.4	2,444.9	2,539.5	2,653.0
	Balance	-1,015.1	-1,153.8	-1,318.2	-1,398.5	-1,477.0	-1,529.4	-1,664.0
Cooch Behar	Available	946.1	934.6	957.6	1,063.5	1,063.5	1,187.8	1,126.0
	Requirement	2,318.8	2,182.1	2,230.2	2,272.0	2,327.6	2,398.5	2,486.4
	Balance	-1,253.9	-1,247.5	-1,272.6	-1,208.4	-1,264.1	-1,210.7	-1,360.4
Kolkata	Available	96.4	100.5	73.6	70.4	64.3	60.2	53.4
	Requirement	80.7	70.6	38.0	37.7	38.4	40.2	39.2
	Balance	15.7	29.9	35.6	32.7	25.9	20.0	14.2

Districts	Available/ Required/ Balance	Dry Matter availability, Requirement and balance *('000 MT)*						
		1997	2003	2007	2008	2009	2010	2011
Malda	Available	1,406.8	1,225.1	1,111.4	1,327.8	1,327.8	1,288.9	1,308.4
	Requirement	1,919.7	1,649.6	1,818.9	1,850.2	1,884.5	1,922.1	1,963.1
	Balance	-512.9	-424.5	-707.5	-522.3	-556.7	-633.2	-654.7
Murshidabad	Available	2,235.6	2,216.7	2,254.4	2,321.5	2,321.5	2,274.2	2,298.0
	Requirement	2,700.2	3,242.1	3,625.1	3,547.0	3,485.8	3,439.5	3,406.6
	Balance	-464.6	-1,025.3	-1,370.7	-1,225.4	-1,164.2	-1,165.2	-1,108.6
Nadia	Available	NA	1,958.5	1,506.1	1,627.9	1,627.9	1,465.8	1,546.9
	Requirement	NA	2,926.0	2,299.1	2,293.3	2,320.8	2,381.3	2,476.1
	Balance	NA	-967.5	-792.9	-665.4	-692.9	-915.5	-929.2
North 24 Parganas	Available	1,232.2	1,248.9	1,215.4	1,238.8	1,238.8	1,152.0	1,195.4
	Requirement	2,961.9	3,286.0	2,714.9	2,733.6	2,799.1	2,912.3	3,075.4
	Balance	-1,729.7	-2,037.1	-1,499.5	-1,494.8	-1,560.3	-1,760.3	-1,880.0
Paschim Medinipur	Available	NA	2,680.2	2,937.2	3,018.4	3,018.4	2,877.5	2,948.0
	Requirement	NA	4,597.5	5,212.3	5,357.1	5,535.8	5,753.5	6,016.8
	Balance	NA	-1,917.3	-2,275.1	-2,338.7	-2,517.4	-2,875.9	-3,068.8
Purba Medinipur	Available	NA	1,047.4	1,661.3	1,445.3	1,445.3	1,645.6	1,545.5
	Requirement	NA	3,245.2	3,085.7	3,184.5	3,312.5	3,468.9	3,655.2
	Balance	NA	-2,197.7	-1,424.4	-1,739.2	-1,867.2	-1,823.3	-2,109.7
Purulia	Available	1,066.4	914.9	1,231.0	1,229.5	1,229.5	1,061.6	1,145.6
	Requirement	2,279.2	2,338.7	2,287.9	2,293.0	2,304.2	2,321.4	2,344.6
	Balance	-1,212.8	-1,423.8	-1,056.9	-1,063.5	-1,074.6	-1,259.7	-1,199.0
South 24 Parganas	Available	NA	1,646.4	1,617.2	1,623.8	1,623.8	1,486.5	1,555.2
	Requirement	NA	3,142.4	2,352.5	2,298.0	2,265.7	2,252.8	2,257.2
	Balance	NA	-1,496.0	-735.4	-674.2	-641.9	-766.3	-702.0
Uttar Dinajpur	Available	NA	1,118.3	1,279.0	1,606.3	1,606.3	1,608.8	1,607.6
	Requirement	NA	1,805.2	1,797.9	1,801.8	1,808.4	1,817.3	1,828.6
	Balance	NA	-686.8	-518.9	-195.6	-202.1	-208.5	-221.0

Source: Feedbase 2012, National Institute of Animal Nutrition and Physiology, Bangalore.

I.5: Review of Literature

India has vast and diverse livestock and poultry population. The contribution of the livestock to the gross value of output of the agricultural sector has been increasing continuously and faster than the crop sector. India is the world's largest producer and consumer of milk and its milk production was about 188 million tonnes in 2019. Livestock sector, which recorded a growth of about 4.9 percent per annum (in value terms) during last decade, has excellent potential for higher growth. Global trend in animal production indicates a rapid and massive increase in the consumption of livestock products. Urbanization has brought a marked shift in the lifestyle of people in feeding habits towards milk products, meat and eggs with resultant increase in demand for livestock products (Ghosh and Palsaniya, 2014b). Rapidly developing peri urban livestock farming, emerging fodder markets, vibrant cooperative dairy sector and livestock product- based super markets are indicators of fast changing economic scenario in livestock sector (Ghosh and Palsaniya, 2014a; Ghosh *et al*., 2013).

The animal husbandry and livestock sectors are critical for the rural economy, especially the small and marginal farmers (Ghosh *et al.,* 2013). They not only contribute to their income but also their best insurance against any natural calamity. Animal products are also playing an important role in their nutritional security. According to NSSO 66th Round Survey (Annual Report, 2013-14), total number of workers in farming of animals is 20.5 million. Marginal, small and semi-medium operational holdings farmers (area less than 4 ha) own about 87.7 per cent of the livestock. Quite often, livestock is the only source of cash income for subsistence farms and also serves as insurance in the event of crop failure. Areas with a high share of livestock husbandry have low poverty percentage (Taneja, 2003). Hence, development of livestock sector would be more inclusive. However, the animals adapted to various agroclimatic regions are low producers due to their genetic potential and inadequate and poor quality of feeds and fodder supply. Many of the animal health problems are further compounded due to poor fodder availability.

Agriculture has come a long way through green revolution but livestock sector could not grow beyond AI and veterinary services. Livestock sector continues to be a subsidiary activity. The forage resource development is a more complex issue than food and commercial crops. On the whole, despite the strong contributions of livestock to local livelihoods and national economies, productivity levels remain low. We have achieved horizontal growth in terms of animal numbers and there is need to achieve vertical growth in terms of improving

productivity. When compared to productivity in other parts of the world, India's livestock sector offers considerable scope for enhancement. The milk productivity of cross bred cow, indigenous cow and buffalo in India is 7.02, 2.36 and 4.80 litre/day, respectively (Annual Report, 2018-19). The cattle and buffalo in India produce nearly 1000 kg of milk per lactation as compared with 4500 kg in Europe, more than 7000 kg in the United States and 10000 kg in Israel. The low productivity of livestock is a matter of great concern.

At present, India faces a critical imbalance in its natural resource base with about 18 per cent human and 15 per cent of livestock population of the world being supported only by 2.4 per cent of geographical area, 1.5 per cent of forest and pasture lands and 4.2 per cent of water resources (Palsaniya *et al.,* 2012a). The three major sources of fodder supply in India are crop residues, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing lands. Due to multiplicity of forage crops grown in different seasons and regions, surplus and deficit in different regions, non-commercial nature of crops and production of forage with minimal inputs from degraded and marginal lands has led to huge gap in fodder availability and requirement. Presently, the country faces a net deficit of 35.6 per cent green fodder, 10.95 per cent dry crop residues and 44 per cent concentrate feed ingredients (IGFRI Vision, 2050). Supply and demand scenario of forage is presented in Table 1.8. Moreover, in case of forages, the regional and seasonal deficiencies are more important than the national deficiencies, as it is not economical to transport the forages over long distances. Furthermore, the available forages are poor in quality and deficient in available energy, protein and minerals. Farmers maintain large herds of animals to compensate for the low productivity, which adds to the pressure on fodder and other natural resources (Palsaniya *et al*., 2008; Palsaniya *et al*., 2009; Palsaniya *et al*., 2010a).

Nearly 2/3rd of total cost in livestock production is due to feed and fodder. Hence, any attempt towards enhancing availability of feeds and fodder, and economizing the feed cost would result in better remuneration to livestock farmers. The area under cultivated fodder is only 8.4 million ha, and has been static during last two decades. The scope for further increase seems to be very low due to demographic pressure for food crops. The recent crop diversification where commercial crops replacing the traditional cereal crops especially the coarse cereals, is likely to have an impact on the availability of crop residues for animal production (Ghosh and Palsaniya, 2014a). Similarly, the productivity of some prominent cultivated forage is highly variable. Among the *kharif* forages, sorghum, maize, cowpea,

Napier x bajra hybrid and Guinea grass have wide amplitude. However, during *rabi*, the choice is limited to oat, lucerne and berseem. Emphasis has to be made on area-specific new crops that can break the yield barriers and meet the challenges of fodder deficits.

Genetic resource enhancement in forage crops remained confined to cultivated crops over many decades. Improvement programmes on range grasses and range legumes were not given proper attention which is a major constraint in the development of grassland and pastures. Twenty prioritized crops are still to be embraced by crop improvement programmes with a due focus on agronomic requirements. Development of improved varieties of perennial grasses and legumes and fodder trees for grasslands and silvipasture has a long way to go. Seed availability of forage crops is just 15-20 per cent of national requirement at much low level of demand under the unorganized seed market. Forage crops in general and range grasses and legumes in particular are shy seed producers. Nucleus and breeder seeds are the major bottleneck to be addressed by forage research network. There is also lack of seed standards for perennial grasses and legumes even after 50 years of organized research in forage crops. This in turn hinders certification /legislation with respect to these crops. There is also need of a separate National Livestock Policy with greater emphasis on feed and fodder. Mission mode approach with a multi- pronged strategy policy and research interventions are required to take care of all aspects of seed production technology, quality, seed standards, certification, distribution and marketing.

The other major issue in fodder production is to reduce the cost of production with international quality standards and in eco-friendly environment. The issues related to the development of forage based cropping system/ silvi-hortipastoral system for extreme weather situations, mitigation and adaptation strategies, standardization and validation of district-wise forage production modules, precision farming in intensive forage based system of milk shed areas, livestock based integrated farming systems for efficient resource use and enhanced farm productivity, forage based contract farming and cooperative farming, utilization of problem soils for fodder production in existing system, silvipasture technologies for reclamation of wasteland and problem areas, region and need specific hortipasture technologies for wide adoption, non-competitive land use pattern for enhancing forage resources, augmenting production from range grasses and trees in watershed areas, grassland and pasture land resource survey and amelioration for enhanced optimum productivity and

enhancing livelihood options for pastoral and nomadic communities by enhancing production of pasture lands/ grasslands etc are to be addressed.

Although we are largest in terms of total milk production, the productivity per unit animal is much lower compared to that in many developed and developing countries. The productivity of small ruminants and pigs is also considerably low and has been stagnating. One of the important factors is feed - fodder scarcity has constrained the productivity growth.

Climate change and its impact on sustainable forage production is another important issue in recent times (Sunil Kumar *et al.,* 2014c; Palsaniya *et al.,* 2012c; Ghosh and Palsaniya, 2014b). India is comparatively more vulnerable to climate change due to large number of populations depend on agriculture and therefore pressure on natural resource increases for their livelihood. The warming trend in India over the past 100 years (1901 to 2007) was observed to be 0.51 ^{0}C with accelerated warming of 0.21^{0}C per every 10 years since 1970. The impact of global warming is seen in the form of increase in intensity and frequency of hydro meteorological disasters like droughts, cyclones and floods etc. at many locations (IPCC, 2007). The forage production per unit area is a consequence of the interactions between genotypes and environment. The varieties with early bulkiness and growth rhythm matching physiology with concurrent weather variability for higher rate of dry matter accumulation and longer leaf area duration in relation to climatic elements find the place in the system (Sunil Kumar *et al.,* 2013). Quick regeneration potential, flexibility to defoliation management and greater persistency under adverse climatic conditions are an added advantage. In longer term, anticipatory adaptation might include the development and use of new crop varieties that offer advantages for the anticipated future climate, or investments in new water management and irrigation infrastructure as insurance against potentially less reliable rainfall. Improved crop management, as well as, better risk management through an early warning system and crop insurance policies can also be beneficial measures to reduce the vulnerability of the farmers (Rai *et al*., 2014). The adaptations can be at the level of individual farmer, farm, society, village, and watershed or even at a national level. Farm level adaptation options can be made in tillage practices, planting and harvest dates, crop rotations, selection of suitable crops and crop varieties for cultivation, water consumption for irrigation, fertilizer management and application of additional nitrogen can reduce the impacts of climate change on forage crops (Palsaniya *et al.,* 2012c; Ghosh and Palsaniya, 2014; Kumar *et al*., 2013). Moreover, adaptation of forage species particularly perennial species and trees

(agroforestry) has ability to produce more forage yield under changing climate and reduces the ill-effect of climate change through carbon sequestration (Kaul *et al.,* 2010; Dhyani *et al.*, 2010; Rai and Palsaniya, 2015 and Palsaniya *et al.,* 2011b). Enhancing the productivity per unit land area through efficient natural resource management and also integration of fodder crops in the existing cropping system are only viable options to meet the growing fodder needs of livestock sector (Sunil Kumar et al., 2012). Improved crop sequences and crop management practices for irrigated and rainfed conditions should be developed to ensure the maximum use efficiency of available resources (Ghosh et al., 2015). Intensive forage production systems include multiple cropping, intercropping, overlapping cropping and relay cropping (Sunil Kumar and Faruqi, 2010). Post-harvest management of surplus fodder is the best mitigating strategy for abating regular phenomenon of seasonal and regional deficit of forage and during natural calamities like drought and flood. Major dependence of livestock on crop residues calls for its effective post-harvest processing, value addition, densification, storage and transport. Bailing and enrichment of crop residues particularly paddy straw and other leguminous crop residues for proper storage, balanced feeding with green fodder and minimizing wastage and storage loss (Pathak *et al.,* 2008).

The current status, potential growth scenario of the livestock and forage sector and their implications for farmers and economy necessitates that the sector should again be high on the research and development agenda. However, the lessons learned regarding productivity and technological solutions need to be explicitly embedded in this agenda. Looking at the vast gap between the demand and supply position, it becomes necessary to put adequate efforts to transfer the potential technologies developed by various research organization in the country to farmer's field in order to increase the production and productivity of good quality fodder.

I.6: Need of the Study

Most of the rural poor in West Bengal are dependent on mixed crop-livestock farming system for their livelihood. Livestock rearing plays a major role in supplementing family income and generating gainful employment in the villages, particularly among the landless laborers, small and marginal farmers and especially women. The contribution of the agriculture sector in total GDP is showing a significant downtrend over the years, whereas the contribution of the livestock sector to the agriculture sector has been showing a significant uptrend. The livestock population in West Bengal is increasing over the years, but not able to raise feed and fodder availability due to the heavy pressure of growing commercial crops. The area

under fodder has been squeezing due to the change in composition of livestock population, inadequate availability of feed and fodder and the decreasing productivity. The increasing consumer nutritional awareness, preferences and changing lifestyle warrant increased demand for quality value-added milk and other livestock products. Concomitantly, there will be a demand for high-quality feed and fodder to sustain high production and produce quality products.

The availability and efficient use of feed resources in India are the primary drivers to maximize the productivity of Indian livestock. Feed security is vital to livestock management, the extent of use, conservation and productivity enhancement. Assessment and forecasting of livestock feed resources are the most important for effective planning and policymaking. The findings of above reviewed studies have amply demonstrated that there existed an overall shortage of all types of feed resources and the existing resources were not sufficient to meet even half of the requirements of bovine stock in certain districts. There is also an inter-district variation in the requirement and availability of feed resources in each state.

It is expected that the population in India would increase and to fulfill the dietary recommended levels of the livestock products as stated by ICMR. From the current level of production, the milk and other livestock products have to increase. 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. Keeping this background, the study examines demand, supply, and a deficit of feed and fodder production in the country.

West Bengal is most densely populated state in India both in terms of human as well as livestock population. The importance of the livestock sector in the economy of West Bengal can be judged from the fact that it contributes 3.89 per cent of the total SDP & 20.34 per cent of the agricultural SDP. It is pertinent to mention here that employment opportunities in traditional agriculture sector are shrinking rapidly and there is virtually no scope for employment of rural unskilled youths in capital intensive industrial units. On the other hand, due to ever increasing population growth and changing food habits, demands for milk, meat, egg & other livestock related products are growing fast. Increased income, rapid urbanization and change in the food habits of the middle & upper strata of the society are increasing the demand for dairy and livestock products in the state. Animal Husbandry and Dairy sectors therefore have the seminal potential to open up new vistas for large scale employment generation in the State.

However, West Bengal is a severely fodder deficient state where a considerable gap between supply and demand for fodder exists particularly during the period of drought and flood. Lack of adequate fodder, is one of the most important constraints for livestock farmers in the state. Scarcity of agricultural land for fodder cultivation and non-availability of green fodder seeds is one of the main constraints to enhance the green fodder cultivation in the state. Adequate infrastructure has not been taken and implemented on priority basis to increase the seed production, development and establishment of feed and fodder bank particularly for the period of drought and flood.

Livestock rearing is one of the most important economic activities in West Bengal but scarcity of feed and fodder scarcity is also a serious constraint for livestock development in the state. In all the agro-climatic regions of West Bengal, population density is very high and due to poor land man ratio very little areas are available for fodder cultivation. Increasing population is creating more pressure on agricultural land which also reducing the pasture or grazing and fodder land of the state. Growing livestock numbers and evolving animal husbandry practices require a corresponding increase in fodder to meet livestock needs. Given the large number of resource-poor households dependent on open grazing for their livestock, revitalizing degraded common fodder and pasture resources and improving fodder productivity are imperative. Therefore, the present study is very much necessary to assess the demand and supply of feed and fodder resources in the state.

I.7: Objectives of the Study

Main objectives of the study are:

1. To estimate the area, production and productivity of major green and dry fodder crops.

2. To study the growth pattern of major livestock production.

3. To assess feed and fodder availability, requirement, deficit/surplus to improve productivity.

I.8.: Methodology of Study

I.8.1: Data

The study is based on both primary as well as secondary data. The secondary data on livestock population of all the districts of West Bengal are compiled from different Quinquennial Livestock Censuses. The Census provides livestock population by districts, species, sex, age, and purpose. For the present study, state and district-wise data on livestock population is collected from the Department of Animal Husbandry and Dairying, Government India for different species viz., cattle, buffalo, sheep and goat for the census periods 1997, 2003, 2007, 2012 and 2019. Further, secondary data on the area under fodder and other relevant crops are collected from various issues of Land Use Statistics of West Bengal and also from the Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare, Govt. of India. Data on feeding rates (feed and fodder) and conversion factors are not available at state level. Therefore, we have used NATP database and conversion factors supplied by the coordinating centre available at national level.

To understand and analyze the demand for and supply of feed and fodder at ground level/household level, primary data are collected with sample survey in three districts. The household survey covered the socio-economic characteristics, and land use and cropping pattern followed by the livestock farmers, details about cost and returns from livestock farming, feeding practices, post harvest management of fodder, constraints faced by them and their suggestions.

I.8.2: Analytical Tools

To meet the objectives of the present study, the primary and secondary data is collected, scrutinized, tabulated and analyzed by employing various analytical tools. The suitable analytical tools employed for analysis of data are discussed briefly in the following subsections. The compound annual growth rate (CAGR) is estimated to analyze the growth pattern between the inter-census periods of the livestock census (cattle, buffalo, sheep, and goat) for the period of 1997 to 2019, as well as for major livestock products like mil, meat, egg and wools. The reference period of the study is 2019-20 agricultural year.

1.8.2.1 Estimation of Demand and Supply of Feed and Fodder

1.8.2.1.1. Availability of Feed and Fodder (Supply)

The authentic data on fodder cultivation are not available for the state. 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 and Farmers Welfare is the sole agency provides data on the area under different crops cultivated in various districts for different years. With respect to green fodder availability, the production is estimated through a potential production per unit hectare from the land classification data as estimated by the *FAO* (2012) and *Ramachandra et al,* (2007) as listed in the Table 1.12. 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 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 availability of crop residues, oil cakes, grains, brans and chunnies used as fodder and concentrates are estimated from production data and using the conversion factors given in Table 1.13. The crop residues are considered as dry fodder whereas oil cakes, grains, brans and chunnies of major crops are considered as concentrates. The dry fodder and concentrates availability from different crops are assessed from production data for the recent years by using following conversion of harvest and extraction ratio as per *FAO* (2012), *Ramachandra et al***.,** (2007). It is 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 study also estimates feed and fodder availability in terms of dry matter (DM), total digestible nutrients (TDN), and crude protein (CP) from available estimates of green fodder, dry fodder and concentrates. Dry matter is the total weight of feed minus the weight of water in the feed. Total digestible nutrient is a measure of the amount of energy that can be obtained from a unit quantity of feed. It is the sum of the digestible fibre, protein, lipid and carbohydrate components present in a feedstuff or diet. Therefore, total digestible nutrient is directly related to digestible energy. Crude protein is a measure of the amount of protein in the feed that can be digested and absorbed by the animal.

The dry matter in green fodder, dry fodder and concentrate is estimated as per the methodology adopted by the earlier workers (*Ranjan et al., 1999; Anandan and Sampath, 2015*; *Tanwar and Verma, 2017; FAO, 2012*), wherein yield from green (green fodder), crop residues (dry fodder), and by-products (concentrates) was calculated on the basis of dry matter (DM) yield assuming 25 percent of green fodder, 90 percent of dry fodder and 90 percent of concentrates, respectively. The factors for conversion 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 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*).

The availability of green forages were estimated as per the following classifications and assumptions as stated in Table 1.12 and that of for dry fodder as stated in Table 1.12.

The fodder availability is calculated by using the following formula:

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

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

Total Green Fodder Availability= (A*40.93) + (B*1.50) + (C*5.00) + (D*1.00) + (E*1.00) + (F*1.00) + (G*1.00).

Total Dry Fodder & Concentrates Availability

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

$\sum QCi = (Yi * HIi \text{ or } ERi) - NFWi$

Where,

QCi = Quantity of crop residues (dry fodder) and concentrates obtained from crop i

Yi = Production of crop I

HIi or ERi=Estimated conversion factor (harvest indices or extraction rate) for crop i

NFWi =Quantity of ‘i’th crop residues going for non-feed uses and waste

Table 1.12: Green Fodder Yields for Land Use Classification

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

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

Table 1.13 Conversion Factors (HI & ER) for Estimation of Dry Fodder and Concentrates Availability Crop Production Data

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 tonnes of utilized crop by-product to tonnes of primary crop harvested

1.8.2.1.2. Requirements of Feed and Fodder (Demand)

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

The Livestock Census, 2019 (GoI, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and State Department Animal Husbandry) is considered to find out the Ruminant Livestock Unit (RLU). This Livestock population in the state is converted into

a standard Ruminant Livestock Unit (RLU) according to species, age and sex (male and female) as per Ramachandra et al., 2007 study and FAO Animal Production and Health manual. The estimation of feed requirement for the livestock is worked out only for 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 fodder requirement for ruminants (cattle, buffaloes, sheep and goats) is 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 1.14.

Table 1.14: 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

The total requirement of feed and fodder is calculated using the standards given by the NATP database as provided in Table 1.15. The animals' category-wise data is collected from the Animal Husbandry Department and the requirement of feed and fodder is be calculated individually and the aggregate demand is calculated by summing up of all categories. Further, an attempt is 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 sampling design is given in next section.

Table 1.15: 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.

1.8.2.1.3. Surplus/Deficit/Gap of Feed and Fodder

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

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

I.8.4: Sampling Framework

The proportionate sampling technique was applied to undertake sample livestock rearers from the purposively selected districts one each from the Southern Coastal Region (North-24 Pargana); Lower Gangetic Plain Region (Burdwan); and Upper Gangetic Plain Region (Murshidabad) of the state of West Bengal. These three districts were also chosen purposively based on the concentration and composition of three different types of livestock namely cattle, buffalo and goats by ranking the individual districts. Therefore, districts having top three ranks were selected representing different regions of the state of West Bengal. From these three districts i.e., North 24 Pargana, Burdwan and Murshidabad, a total of 120 Cattle rearing farmers, 120 Buffalo rearing farmers and 120 Sheep & Goat rearing farmers were surveyed with a pre prepared questionnaire following proportionate sampling i.e. based on proportion of cattle, buffalo and sheep & goat population existing in the selected districts. In the next state, from these selected districts, a cluster of villages were selected

based on the density and diversity of animal population i.e., cattle, buffalo and small ruminants. 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 is considered as more than one sample. Therefore, a total of 150 sample households covered the requirements of 120 Cattle rearing farmers, 120 Buffalo rearing farmers and 120 Sheep & Goat rearing farmers. Detailed sampling frame is given in Table 1.16.

Table 1.16 Sampling Frame: Livestock Rearing Farmers in West Bengal

District	Buffalo rearing farmers	Cow rearing farmers		Goat rearing farmers	Net Sample Households
		Crossbreed	Indigenous		
North 24 Parganas	27	31		29	40
Burdwan	63	57		47	65
Murshidabad	30	32		44	45
Total	**120**	**120**		**120**	**150**

I.9.: Organization of the Report

The present report is organised into five chapters. Chapter- I, which is the current chapter, provides the background of the study, along with a brief description about the livestock scenario in the state; need and objectives of the study; a brief review of literature relevant to the topic; as well as study design and methodology adopted for the study. The second chapter essentially deals with the socio-economic characteristics of the sample farmers. Estimation of feed and fodder at household level is presented in Chapter-III. Constraints faced and suggestions given by the sample households are discussed in Chapter-IV. And finally, major findings of the study along with policy suggestions are covered in Chapter-V.

Chapter – II

Socio-Economic Characteristics of Sample Households

This chapter provides the socio-economic profile of the sample households (which are mainly livestock farmers) drawn from the study area. The socio-economic characteristics of the sample households would provide the background information and resource endowment position of the farmers in the study area. This chapter mainly deals with the socio-economic characteristics of sample households, particularly their demographic features like age, caste, gender, literacy, average family size, etc. as well as the agrarian features like livelihood pattern, working experience in the field of crop-farming, dairying, sheep & goat rearing, etc; and income from different livelihood avenues. It also gives an idea about involvement of the sample households in village level social and cooperative organizations. The data collected on all of these parameters are presented in Table 2.1 for different categories of livestock rearing households.

II.1: General Characteristics of the Sample Households

A close perusal of the table 2.1 shows that in terms of different variables (demographic as well as livelihood), there is very little variation across the categories of farmers. This is mainly because as many as 70 households are common to each and every categories of households.

1. **Average Age of the Sample Households**

   Average age of the respondents is more or less uniform across the categories of farms and is around 48 years. However, a detailed look at the demographic profile of the sample households reveals that the age of the responding farmers varies from 27 years to 70 years with an average of almost 48 years.

2. **Education Level-wise Classification of Sample Households**

   Average education level of the respondents is observed to be relatively low. Only 9 persons of the sample (6 per cent) have pursued their studies beyond matriculation level of education, showing low literacy standards among rural farming households. Close to almost half of the respondents (42.67 per cent) are either illiterate or studied only up to primary standard. A mere 18.67 percent of respondents have studied up to matriculation level and 32.67 percent of respondents have completed higher primary level of education in the study area.

Table 2.1: General Characteristics of the Sample Households

Particulars	Household Categories (Based on livestock rearing)							
	Cattle	**Buffalo**	**Goat**	**Cattle & Buffalo**	**Cattle & Goat**	**Buffalo & Goat**	**Cattle, Buffalo & Goat**	**Overall**
Sample Size (No. Of HH)	120	120	120	96	95	93	70	150
Average Age of the Respondent (Years)	47.97	42.69	48.25	47.94	48.56	48.34	48.73	47.73
Education Level (Number)								
Illiterate	18	21	15	17	11	14	10	22
Primary (1 to 4)	34	33	36	27	29	29	22	42
Higher Primary (5 to 9)	36	34	39	26	30	25	18	49
Matriculation (10)	24	24	23	20	20	19	23	28
Pre-University (10+2)	1	1	1	1	1	1	1	1
Graduate	7	7	6	5	4	5	3	8
Education Level (%)								
Illiterate	15.00	17.50	12.50	17.71	11.58	15.05	14.29	14.67
Primary (1 to 4)	28.33	27.50	30.00	28.13	30.53	31.18	31.43	28.00
Higher Primary (5 to 9)	30.00	28.33	32.50	27.08	31.58	26.88	25.71	32.67
Matriculation (10)	20.00	20.00	19.17	20.83	21.05	20.43	32.86	18.67
Pre-University (10+2)	0.83	0.83	0.83	1.04	1.05	1.08	1.43	0.67
Graduate	5.83	5.83	5.00	5.21	4.21	5.38	4.29	5.33
Caste (No of HH)								
General	56	46	60	38	48	39	29	70
OBC	28	21	30	22	24	24	18	37
SC	17	20	15	17	12	15	12	20
ST	19	23	15	19	11	15	11	23
Caste (%)								
General	46.67	38.33	50.00	39.58	50.53	41.94	41.43	46.67
OBC	23.33	17.50	25.00	22.92	25.26	25.81	25.71	24.67
SC	14.17	16.67	12.50	17.71	12.63	16.13	17.14	13.33
ST	15.83	19.17	12.50	19.79	11.58	16.13	15.71	15.33
Gender of the Respondent (No of HH)								
Male	116	116	115	94	92	90	69	144
Female	4	4	5	2	3	3	1	6
Gender of the Respondent (%)								
Male	96.67	96.67	95.83	97.92	96.84	96.77	98.57	96.00
Female	3.33	3.33	4.17	2.08	3.16	3.23	1.43	4.00
Average Experience (Years)								

Farming	25.69	25.48	25.62	25.92	26.13	25.92	26.61	26.32
Dairying	28.21	28.05	28.02	28.45	28.76	28.94	29.29	28.13
Sheep & Goat Rearing	28.00	28.83	29.56	28.00	29.39	29.30	29.53	28.88
Average Family Size	4.74	4.81	4.81	4.80	4.79	4.88	4.90	4.77
Average Income (INR /Household)								
a) Agriculture	97330	99903	97981	109556	108583	112856	129370	90254
b) Dairy	360067	372707	271851	413933	286980	303741	334751	335380
c) Goat Farming	27226	28201	29016	25256	26923	27903	24817	29237
d) Others	36352	33553	40661	29044	27207	33970	28233	39570
Average No. of Family Members Engaged								
Farming	1.39	1.39	1.41	1.43	1.43	1.43	1.49	1.37
Dairying	2.61	2.71	2.69	2.69	2.69	2.78	2.83	2.65
Goat Rearing	2.61	2.7	2.7	2.69	2.69	2.78	2.83	2.65
Primary Occupation (Number)								
Agriculture	6	4	8	2	5	3	1	9
Animal Husbandry & dairy	113	116	109	94	89	90	69	138
Agricultural Labour	0	0	0	0	0	0	0	0
Non-Farm Labour	1	0	3	0	1	0	0	3
Primary Occupation (% HH)								
Agriculture	5.00	3.33	6.67	2.08	5.26	3.23	1.43	6.00
Animal Husbandry & dairy	94.17	96.67	90.83	97.92	93.68	96.77	98.57	92.00
Agricultural Labour	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-Farm Labour	0.83	0.00	2.50	0.00	1.05	0.00	0.00	2.00
Secondary Occupation (Number)								
Agriculture	97	104	94	87	76	80	64	119
Animal Husbandry & dairy	7	4	10	2	6	3	1	11
Agricultural Labour	8	6	6	6	6	4	4	8
Non-Farm Labour	8	6	10	7	7	4	1	12
Secondary Occupation (% HH)								
Agriculture	80.83	86.67	78.33	90.63	80.00	86.02	91.43	79.33
Animal Husbandry & dairy	5.83	3.33	8.33	2.08	6.32	3.23	1.43	7.33
Agricultural Labour	6.67	5.00	5.00	6.25	6.32	4.30	5.71	5.33
Non-Farm Labour	6.67	5.00	8.33	7.29	7.37	4.30	1.43	8.00
Member of Social & Cooperative Organization (Number & %)								
Number of Households	41	46	46	35	37	39	31	53
% of Households	34.17	38.33	38.33	36.46	38.95	41.94	44.29	35.33

Source: ***Field Survey***

3. Caste-wise Classification of Sample Households

Caste composition of households' reveals that 40 to 50 per cent of sample households (around 46.67 percent) belongs to General category and the rest of the sample is divided among OBC (24.67 per cent), SC (13.33 per cent) and ST (15.33 per cent) categories. Thus, it has been observed that the study area is dominated by General category of caste.

4. **Gender-wise Classification of Sample Households**

   The sample respondents predominantly consists of males (96 per cent), reflecting the women being engaged in supporting roles in rural livelihoods or enterprises.

5. **Average Experience of the Sample Households**

   Preliminary information on work experience reveals that although respondent have an average 25.32 years of experience in farming, they have additional three years of experience in cattle and goat farming. The respondents have 28.13 and 28.88 years of experience in dairying and goat rearing, respectively. Probably the reason is the respondents started their career with livestock rearing at home and to assist the family for this purpose. It is evident from the collected data that the primary occupation is animal husbandry and livestock rearing is seen in more than 90 percent of the respondents'.

6. **Average Family Size of the Sample Households**

   Family human labour is a major source of labour required for carry out timely all type of farming as well as livestock rearing operations and other allied activities. The extent of availability of family human labour directly impacts the paid out cost of farming business. The availability of family human labour is directly related with the size and composition of family and number of economically active workers in the family. In this context, the average family size of sample households and availability of economically active workers are mentioned here. The average family size of the sample households is 4.77, which is almost similar to West Bengal average (*as per census 2011, average family size in West Bengal is 4.5*).

7. **Average Income of the Sample Households**

   It is evident from the collected information from the sample households that average annual family income in dairying is INR 335,480, which is 372 percent higher than the average income from agriculture (INR 90,254). So, it can be concluded that the sample households are primarily dependent on dairy enterprise for their livelihoods. The income of goat rearing is observed to be quite low (INR 29,237), indicating that it

is not a prevalent occupation among sample households. In addition, some families have been found to earn an average of INR 39,560 in a year from other sources.

8. **Average No. of Family Members Engaged in Different Livelihood-Activities**

The relevant information is also supported by the average number of family members engaged in dairying as well as goat rearing (2.65), which is almost double to the corresponding figure in agriculture (1.37). Thus, dairying has emerged as employing the higher number of members' occupation in the study area. However, the income from goat rearing is substantially lower. So, it seems that same person takes care of dairying as well as goat rearing.

9. **Occupation-wise Classification of Sample Households:**

Dairying is the main source of livelihood of our sample farmers. The occupational status reveals that out of total 150 sample households, 138 households (92 per cent) are primarily engaged in animal husbandry & dairying. Among the rest, 9 and 3 households are primarily depended on agriculture and non-farm activities, respectively for their livelihood. This information clearly underlines the statement, "primary occupation of almost all the sample households are animal husbandry & dairying" in the study area. On the other hand, secondary occupation of total 150 sample households is fragmented as follows: 119 respondents (i.e. 79.33 per cent of total respondents) have opted agriculture, 11 respondents (i.e. 7.33 per cent of total respondents) have opted animal husbandry & dairying, 8 respondents (i.e. 5.33 per cent of total respondents) have opted agricultural labour and 12 respondents (i.e. 8 per cent of total respondents) have opted non-farm labour. Thus, it may conclude that the sample households are mostly engaged in animal husbandry & dairying and agriculture as their primary and secondary occupation respectively in the study area. In other words, maximum of the sample households are found to be engaged either in allied agriculture or in agriculture in the area under study in the state of West Bengal.

10. **Member of Social & Cooperative Organization:**

It is also observed that out of total 150 sample households (about 35 percent of total surveyed households), only 53 members from 53 households have a membership in social or co-operative institutions in the study area.

Chapter – III

Estimation of Area, Production and Productivity of Feed and Fodder Crops Being Fed to Livestock by Sample Households

In this chapter we shall discuss mainly about the land use pattern, sources of irrigation and cropping pattern practiced by the sample household as well as feed and fodder fed to different categories of animals, availability of sheds and returns from livestock rearing by the sample households. District-wise classifications of animals reared by the sample households along with their value are also heighted in this chapter. Detail calculation of the feeds and fodders fed to major animals per day per animal is also presented in this chapter. Since there is no authentic data on fodder cultivation is available, the feed and fodder availability in West Bengal is estimated using latest available (2018-19) land use classification data as well as crop production data as discussed in methodology section (FAO, 2012: Ramchandra et al, 2007). The requirements of feed and fodder in West Bengal is worked out through different standards as estimated by FAO, NATP feeding rates as well as actual feeding practices is the state using our primary field survey data. In all the three cases we have used latest available livestock census data (2019). Besides, information regarding major sources of livestock feed, nature of cattle shed, details of labour and other maintenance charges, and returns from livestock rearing are also enlisted in this chapter.

III.1: Land Use Pattern

The total land holding of the surveyed households is 406.44 acres with an average size of holding 2.70 acres. The net operated area of the sample household is 380.61 acres, out of which about 328.95 acres (86.43 per cent) is irrigated. While the area of the leased-in and leased-out land in the study area is accounted as 24.66 acres and 33.40 acres, respectively, a total land of 17.09 acres remained uncultivated during the survey period mainly because of lack of irrigation facility and erratic rainfall. The primary source of irrigation among the sample farmers is bore well (50.46 per cent by numbers of respondents), followed by dug well (30.09 per cent), shallow tube well (18.98 per cent) and tank (0.46 per cent).

Livestock farming is the main occupation of 92 per cent of sample households and secondary occupation for remaining households (Table 2.1). However, in-spite of this, the area under fodder crops is only 13.35 acres, constituting about a mere 4 percent of the net sown area. Though the individual sample households do not own any agro-forestry or grazing land,

indigenous cattle and goat reared by them relies heavily on common property resources like public grazing land and nearby forests.

Table 3.1: Landholding and Source of Irrigation

(Area in Acre)

Sl.No	Particulars	Irrigated	Un-Irrigated	Total
1	Owned Land (Acres)	338.19 (2.25)	68.25 (0.45)	406.44 (2.70)
2	Leased in Land (Acres)	24.16 (0.16)	0.50 (0.01)	24.66 (0.16)
3	Leased out Land (Acres)	33.40 (0.22)	0.00 (0.00)	33.40 (0.22)
4	Uncultivated Land (Acres)	0.00 (0.00)	17.09 (0.11)	17.09 (0.11)
5	Net Operated Area (Acres)	328.95 (2.19)	51.66 (0.34)	380.61 (2.53)
6	Area Under Fodder Crop (Acres)	13.35 (0.09)	0.00 (0.00)	13.35 (0.09)
7	Village Agro Forestry (Acres)	-	-	-
8	Village Grazing Land (Acres)	-	-	-
9	Other (specify)	-	-	-
10	**Source of Irrigation (In Number)**			
		No.	**%**	
i)	Canal	-	-	
ii)	Bore Well	109	50.46	
iii)	Dug Well	65	30.09	
iv)	Tank	1	0.46	
v)	Other (*Shallow Tube Well – STW*)	41	18.98	

Source: ***Field Survey*** ***Note:*** *Figures in parenthesis are average per household*

III.2: Cropping Pattern

As enumerated before, the households have access to irrigation which is reflected in the cropping pattern in the three main cropping seasons. The entire rabi and summer cultivation is under irrigated lands, whereas most of the paddy is also grown in irrigated system. The cropping pattern of the sample households are dominated by paddy (both in kharif and summer), potato and mustard crops. Cultivation of fodder crop is very limited. In the Kharif season, the predominant crop is Amon paddy whereas in the Rabi season, it is mostly Potato followed by Mustard. Boro paddy is the main crop in summer. The net returns from per acre cultivation of crop is highest for Potato (INR 85,615.64), followed by Amon paddy (INR 13,144.34), Boro paddy (INR 12,895.15) and Mustard (9,473.37). The fodder crops grown in Kharif season are Maize and Gama grass while during the Summer season, Maize and Sudan grass is grown and in Rabi season, only Barley grass is grown. The net returns from one acre

cultivation of land for Maize and Gama grass in Kharif season is INR 13,480.24 and INR 14,913.64 respectively. Besides, Barley grass as fodder crop in Rabi season gives a net return by INR 14,197.26 from an acre of land. The net returns for Maize and Sudan grass from per acre land in Summer season are INR 13,685.16 and INR 11,941.48 respectively. The competing crop in Kharif season of fodder crop is Amon paddy. The net returns are almost similar for these two types of crop but paddy is mostly grown as it ensures food security for the farming households. This is the reason for much lower aggregate income for paddy in comparison to dairy enterprise, as the marketable surplus of Amon paddy is low (Table 3.2). Except for potato which gives a much higher return, the returns from cultivation of various food crops and fodder crops are almost similar. The higher preference for cultivating food crops is due to perceived food security for the family and age-old practice.

Table 3.2: Cropping Pattern of Sample Households

(Area in Acre)
(Production in Qtl/Acre)
(Cost & Return in INR/Acre)

Name of Crop	Irrigated Area (Acre)	Rainfed Area (Acre)	Total Area (Acre)	Production (Qtl/Acre)		Total Cost/Acre (INR/HH)	Total Return/Acre (INR/HH)
				Main Product	By-product		
Kharif/Rainy							
Amon Paddy	299.26 (2.00)	37.80 (0.25)	337.06 (2.25)	18.37	10.17	13,843.68 (31107.67)	26,988.02 (60643.88)
Maize Grass	3.34 (0.02)	0.03 (0.00)	3.37 (0.02)	292.47	0.00	8,695.39 (195.36)	22,175.63 (498.21)
Gama Grass	1.76 (0.01)	0.00 (0.00)	1.76 (0.01)	286.42	0.00	8,000.00 (93.87)	22,913.64 (268.85)
Rabi/Winter							
Potato	90.69 (0.60)	0.00 (0.00)	90.69 (0.60)	190.64	0.00	46,217.33 (27943.00)	1,31,832.97 (79706.21)
Mustard	35.13 (0.23)	0.00 (0.00)	35.13 (0.23)	3.80	2.09	6,106.29 (1430.09)	15,579.66 (36.48.76)
Barley Grass	2.56 (0.02)	0.00 (0.00)	2.56 (0.02)	301.56	0.00	9,216.80 (157.30)	23,414.06 (399.60)
Summer							
Boro Paddy	62.76 (0.42)	0.00 (0.00)	62.76 (0.42)	27.02	1.48	21,449.97 (8974.67)	34,345.12 (14370.00)
Maize Grass	2.56 (0.02)	0.00 (0.00)	2.56 (0.02)	290.92	6.43	8,876.95 (151.50)	22,562.11 (385.06)
Sudan Grass	4.87 (0.03)	0.00 (0.00)	4.87 (0.03)	305.44	0.00	8,766.94 (284.63)	20,708.42 (672.33)

Source: ***Field Survey*** ***Note:*** *Figures in parenthesis are average values per household*

III.3: Classification of Animals

The district wise classification of animals of sample households is presented in Table 3.3. It should be noted here that even though cattle and goat dominates the livestock sector in West Bengal, as per study design discussed in section I8.4, equal number of sample households were chosen for buffalo, cattle (including crossbred and indigenous) and goat following proportionate (across districts) and purposive (livestock concentration) sampling technique. There was no sheep rearing farmer in the study area. Further, several of our sample farmers are basically commercial milk producer rearing a large number of crossbred cattle and buffaloes. Therefore caution should be taken while comparing composition of livestock in sample households with that of state average.

It can be seen from the Table that female in cattle (in buffalo, crossbred as well in indigenous cattle) and male in goat dominates the total livestock in our sample households. The share of female (in total), ranges between 83 to 86 per cent in cattle and only 17 per cent in case of goat. This is mainly because, in West Bengal, bovines are mostly reared for milk purpose while goat for mutton. Across the sample districts, total number of selected livestock is maximum in Burdwan district (48 per cent), followed by Murshidabad (27 per cent) and North 24 Parganas (25 per cent). This is in commensurate with number of sample household drawn from these districts as discussed in Table 1.15. Average number of livestock per household is 8.89 in Murshidabad, 9.25 in North 24 Parganas and 10.74 in Burdwan. However, if we look into the composition of different types of livestock reared by the sample household it can be seen that the share of buffalo as well as crossbred cattle population is much higher in North 24 Parganas district, whereas share of goat and indigenous cattle is maximum in Murshidabad district. This is because of geographical location of these districts. The location of North 24 Parganas district is adjacent to the state capital Kolkata. Thus, from the commercial point of view, the district has an advantage of selling bulk quantity of milk as well as processed dairy products. In contrary to that, Murshidabad is mostly a rural district with widespread poverty but higher public grazing land. Therefore, rearing goat and indigenous cattle is a common proposition in this district. Burdwan is also a rural district but it is also the second richest district in West Bengal (after Kolkata), with quite a few town and cities like Asansol, Durgapur, Baardhaman, Raniganj, Kalna, Katwa, Galsi, Budbud, Ukhra, Andal, Gushkara, Memari, Kulti, Jamuria, Pandabeswar, Burnpur, etc.

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

(In numbers)

SN	District	Buffalo		Cross Bred Cattle		Indigenous Cattle		Goat	
		Male	Female	Male	Female	Male	Female	Male	Female
1	N/24 Pgs	28	125	22	57	13	50	60	15
2	Burdwan	23	180	16	103	16	134	199	27
3	Murshidabad	12	80	9	62	16	75	110	36

Source: ***Field Survey***

III.4: Value of Different Animals

The percentage of male goats was about 78 percent across the sample households as it fetched higher returns than female goats for their higher body weight as well as higher price of meat. This is further supported by the estimates of value of male goats after one year which shows about 1200 percent increase in the sample than less than one year male goat. The similar figure for female goats is 347 percent. (*Table 3.4*) As shown in table 3.5, the value (*i.e. purchasing price*) of milch, dry and pregnant heifers is higher than male animals across three types of milch animals, i.e. buffalo, cross bred cows and indigenous cows. Interestingly, the purchasing price of cross bred cows is higher followed by buffaloes and indigenous cattle. (*Table 3.5*)

Table 3.4: Average Value of Goat Based on Their Age

(Average Value in INR/Animal)

Age group	Sheep		Goat	
	Male	Female	Male	Female
<1 year	-	-	1265.43	1377.27
1-2 Year	-	-	15223.33	4781.34
>2 Years	-	-	18017.00	-

Source: ***Field Survey***

The fact is that crossbred cows give more milk than buffaloes. But the price per litre of milk of the buffalo is higher. As has been observed in the study area from the financial point of view, the buffaloes and crossbred cows produces almost equal income from selling milk. But the daily expense for rearing a crossbred cow is much lower (almost 20 per cent) than that of a buffalo. The average daily cost for rearing an adult buffalo is around Rs. 112, while the average daily cost for rearing a crossbred cow is around Rs. 90. Perhaps that's why crossbred cows are in high demand, and therefore their prices are even higher.

III.5: Details of Fodder & Feed Fed to Animals

The nutritional status of the livestock and their productivity mostly depends on the amount and type of feed fed. Livestock feeds are classified as roughages and concentrates, the former being further classified into green fodder and dry fodder. Most of the feed comes from agricultural residues. Green fodder is cultivated by few sample farmers and fed to the animals in the form of forage (cut green and fed fresh) and hay (dehydrated green fodder). Silage making (preservation of green fodder under anaerobic condition) is not a common practice in the study area. The cattle and buffaloes in the study area are also fed with rice husk (bhusi) but which neither nutritional nor advised by the animal husbandry professionals. However, we have not considered the same in our feed and fodder estimates in the following sections.

Table 3.5: Average Value of the Buffalo, Cross Bred & Indigenous Cattle

(Average Value in INR/Animal)

Particulars	Buffalo	Cross Bred Cattle	Indigenous cattle
Milching	53,493.00	60,403.00	30,250.00
Dry	54,028.00	54,429.00	34,513.00
Male	29,072.00	25,904.00	16,560.00
Heifer Pregnant	49,006.00	58,300.00	24,625.00
Heifer Non-Pregnant	23,195.00	15,454.00	14,140.00
<1 year	17,004.00	15,147.00	13,337.00
1-2 Year	22,500.00	15,500.00	NA

Source: ***Field Survey***

III.5.i): Fodder & Feed Fed to Buffalos

The details of feed and fodder fed to the buffaloes by the sample farmers are presented in Table 3.6. A perusal of the table reveals that on an average an adult buffalo is fed with 4.5 to 5 kgs of green fodder, 5.5 to 7 kgs of dry fodder, 0.5 to 1 kg concentrates and a small quantity of supplements (sold as vitamin powder) per day. Milching buffaloes are fed a higher amount of feed and fodder than male or dry buffaloes. These estimates are slightly lower than NATP estimates (Table 1.14) but are compensated by 4.5-6 hours of grazing per day. Details of feed cost per animal per day are also presented. As per data enlisted in *Table 3.6,* the average feed cost per day per animal for a milch buffalo is INR 69.54. Similar figures for dry buffalo, male buffalo, pregnant heifer, non-pregnant heifer, less than one year buffalo and one to two year buffalo is INR 45.56, INR 40.88, INR 41.51, INR 34.85, INR 11.00 and INR 17.26, respectively. The concentrates and dry fodder constitute more than 75 per cent of the total

cost. Share of green fodder in the total cost is around 6 to 8 per cent only. Rest is for supplements.

III.5.ii): Fodder & Feed Fed to Cross Bred Cattle

The average feed and fodder fed to crossbred cattle per day per animal is given in Table 3.7. As evident from the table, on an average, one adult crossbred cattle is fed 4 kgs green fodder, 5.5 kgs dry fodder, 0.5 to 1 kg concentrate and 50 gms of vitamin powder as supplements per day. Daily average feed and fodder fed to milch cattle is slightly higher than other categories of crossbred cattle. It is important to note that crossbred cattle's are completely stall-fed. It is also evident from the table that average feed cost per day per animal for a milch cross bred cattle is INR 57.64 more or less equal for that of pregnant heifer (INR 57.72) followed by dry cattle (INR 49.81), adult male (INR 40.06) and minor crossbred (INR 13.11 & INR 11.48).

III.5.iii): Fodder & Feed Fed to Indigenous Cattle

The details of feed and fodder fed to the indigenous cattle by the sample farmers are presented in Table 3.8. It can be seen from the table that except minor (<1year age), daily average quantity of green fodder, dry fodder and concentrates are around 4.5 kgs, 6.5 kgs and 0.5 kgs, respectively. The data in *Table 3.8* reveals that the average feed cost per day per animal for milch indigenous cattle is INR 55.23. The corresponding figures for dry indigenous cattle, male indigenous cattle, pregnant heifer, non-pregnant heifer and less than one year indigenous cattle is INR 50.97, INR 49.47, INR 50.32, INR 39.62 and INR 12.80, respectively. There were no indigenous cattle in the age group 1-2 years in our sample households. The supplements constitute nearly 15-18 per cent of the total feed-costs, except for less than one year indigenous cattle.

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

(Quantity in kg)
(Price in INR/Qtl)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Grazing (hrs/day)
	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	
Milching	5.05	75.00	6.83	367.00	1.12	2834.25	0.046	19433.85	5.67
Dry	4.57	77.66	5.53	368.54	0.51	2834.85	0.037	19453.79	6.00
Male	4.50	75.23	5.60	379.61	0.34	2780.61	0.035	19358.50	-
Heifer Pregnant	3.79	78.00	5.87	370.21	0.32	2758.09	0.042	19067.20	4.50
Heifer non-pregnant	3.74	78.87	5.21	362.00	0.27	2868.47	0.028	18920.26	-
<1 year	0.85	75.56	1.20	367.26	0.21	2838.82	-	-	5.67
1-2 Year	1.15	73.33	2.58	376.67	0.23	2907.69	-	-	6.00

Source: ***Field Survey***

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

(Cost in INR/day/Animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Total cost/day / animal
	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	
Milching	3.79	5.45	25.07	36.05	31.74	45.64	8.94	12.86	69.54 (100%)
Dry	3.56	7.81	20.35	44.67	14.45	31.72	7.20	15.80	45.56 (100%)
Male	3.38	8.27	21.28	52.05	9.45	23.12	6.77	16.56	40.88 (100%)
Heifer Pregnant	2.96	7.13	21.72	52.32	8.83	21.27	8.00	19.27	41.51(100%)
Heifer non-pregnant	2.95	8.46	18.86	54.12	7.74	22.21	5.30	15.21	34.85 (100%)
<1 year	0.64	5.82	4.40	40.00	5.96	54.18	-	-	11.00 (100%)
1-2 Year	0.84	4.87	9.73	56.37	6.69	38.76	-	-	17.26 (100%)

Source: ***Field Survey***

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

(Quantity in kg)
(Price in INR/Qtl)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Grazing (hrs/day)
	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	
Milching	4.12	93.51	5.53	365.21	0.80	2865.89	0.055	19441.51	-
Dry	3.61	89.48	6.19	366.48	0.50	2863.83	0.050	19205.18	-
Male	4.30	85.81	5.35	372.00	0.33	2855.00	0.036	19586.00	-
Heifer Pregnant	4.02	86.55	5.48	370.64	0.87	2875.86	0.047	19048.62	-
Heifer non-pregnant	-	-	-	-	-	-	-	-	-
<1 year	0.51	86.09	1.45	387.18	0.19	2860.82	-	-	-
1-2 Year	0.78	83.00	1.87	358.00	0.20	2885.00	-	-	-

Source: ***Field survey***

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

(Cost in INR/day/Animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Total cost/day / animal
	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	
Milching	3.85	6.68	20.18	35.01	22.92	39.76	10.69	18.55	57.64 (100%)
Dry	3.23	6.48	22.66	45.49	14.32	28.75	9.60	19.22	49.81 (100%)
Male	3.69	9.21	19.90	49.68	9.42	23.51	7.05	17.60	40.06 (100%)
Heifer Pregnant	3.48	6.03	20.28	35.14	25.01	43.33	8.95	15.51	57.72 (100%)
Heifer non-pregnant	-	-	-	-	-	-	-	-	-
<1 year	0.44	3.83	5.61	48.87	5.43	47.30	-	-	11.48 (100%)
1-2 Year	0.65	4.96	6.69	51.03	5.77	44.01	-	-	13.11 (100%)

Source: ***Field survey***

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

(Quantity in kg)
(Price in INR/Qtl)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Grazing (hrs/day)
	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	
Milching	4.60	82.59	5.74	376.98	0.69	2870.32	0.05	19939.02	5.55
Dry	4.53	81.17	6.47	386.75	0.50	2885.00	0.04	19592.67	5.50
Male	4.38	87.42	6.88	344.00	0.50	2837.50	0.04	19525.00	-
Heifer Pregnant	4.51	76.91	6.19	368.08	0.56	2877.78	0.04	19899.38	5.00
Heifer non-pregnant	4.17	76.47	5.67	357.65	0.35	2861.91	0.03	19666.67	6.00
<1 year	1.19	82.82	1.99	376.80	0.15	2870.17	-	-	5.55
1-2 Year	-	-	-	-	-	-	-	-	-

Source: ***Field survey***

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

(Cost in INR/day/Animal)

Particulars	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Powder)		Total cost/day / animal
	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	
Milching	3.82	6.91	21.64	39.18	19.80	35.86	9.97	18.05	55.23 (100%)
Dry	3.67	7.20	25.04	49.12	14.43	28.30	7.84	15.38	50.97 (100%)
Male	3.81	7.70	23.67	47.84	14.19	28.67	7.81	15.79	49.47 (100%)
Heifer Pregnant	3.47	6.90	22.78	45.27	16.11	32.02	7.96	15.82	50.32 (100%)
Heifer non-pregnant	3.17	8.00	20.30	51.24	10.02	25.44	5.90	14.89	39.62 (100%)
<1 year	0.99	7.72	7.50	58.63	4.31	33.65	-	-	12.80 (100%)
1-2 Year	-	-	-	-	-	-	-	-	-

Source: ***Field survey***

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

(Quantity in kg & number)
(Price in INR/Qtl & INR/100 pcs)

Particulars	Gender	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Tablet)		Grazing (hrs/day)
		Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (Kg)	Price (INR/Qtl)	Quantity (No.)	Price (INR/ 100 pcs)	
<1 year	Male	0.86	80.60	0.37	354.76	0.10	517.16	1.54	475.62	4.81
	Female	0.78	83.22	0.33	307.03	0.10	500.00	1.73	479.37	4.75
1-2 Year	Male	1.27	77.31	0.54	373.97	0.15	508.74	3.99	483.63	4.78
	Female	1.16	80.04	0.52	369.54	0.15	516.28	3.98	482.27	4.78
> 2 Years	Male	1.50	81.67	0.63	376.23	0.19	498.80	3.92	487.32	4.75
	Female	-	-	-	-	-	-	-	-	-

Source: ***Field survey***

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

(Cost in INR/day/Animal)

Particulars	Gender	Green fodder		Dry fodder		Concentrates		Supplements (Vitamin Tablet)		Total cost/day / animal
		Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	Cost (INR)	% to Total	
<1 year	Male	0.70	15.52	1.31	29.05	0.52	11.53	1.98	43.90	4.51 (100%)
	Female	0.65	14.71	1.01	22.85	0.50	11.31	2.26	51.13	4.42 (100%)
1-2 Year	Male	0.98	10.77	2.01	22.09	0.76	8.35	5.35	58.79	9.10 (100%)
	Female	0.93	10.39	1.92	21.45	0.77	8.60	5.33	59.55	8.95 (100%)
> 2 Years	Male	1.23	12.75	2.37	24.56	0.75	7.77	5.30	54.92	9.65 (100%)
	Female	-	-	-	-	-	-	-	-	-

Source: ***Field survey***

III.5.iv): Fodder & Feed Fed to Goats

The average feed and fodder fed to goat per day per animal is given in Table 3.9. As evident from the table, on an average, an adult goat is fed with 1-1.5 kg green fodder, 0.5 kg dry fodder and 0.1 to o.2 kg concentrates per day. Goats are also fed with vitamin and mineral tablets as supplements. Average daily grazing time for goats in the study area is 4.75 hrs. The table also reveals that average feed cost per day per goat ranges from INR 4.42 to INR 9.65. Cost of supplements is the most important item of feed cost for goat in the study area. Generally, tablets in multiple numbers of different mineral groups and of various vitamin types are fed to goat for their nourishment depending upon their age at a regular intervals of three months.

In this chapter, we have discussed so far as in details the area, production and productivity of the fodder crops. In addition, the pattern of livestock population and cost of feed and fodder required per day per animal of different categories under this survey programme is also seen. The results show that per day feeding cost is highest for buffalo among different categories of livestock followed by crossbred cattle, indigenous cattle and goat.

Table 3.10: Green Fodder Yields from Land Use Classification

SN	Land use category	Green fodder (tonnes/ha/year)	Total Area(hectares)	Total Availability
1	A) Area under fodder crop	40.93	3500	143255
2	B) Forest area and on assumption that only 50% area was accessible for grazing	3.00 (1.50 if considered whole forest area)	1175161	1762742
3	C) Permanent pastures and other grazing lands	5.00	2114	10570
4	D) Cultivable wastelands	1.00	12997	12997
5	E) Current fallows	1.00	306615	306615
6	F) Other fallows	1.00	5500	5500
7	G) Misc. Tree Crops and Groves not Included in Net Area Sown	1.00	46787	46787
	Total (Tonnes)	-	-	**2288466**

Source: FAO (2012), Ramachandra et *al*, 2007; Land use Statistics (2018-19)**,** Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India, New Delhi.

III.6: Estimated Availability of Feed and Fodder in West Bengal

So far as availability of green fodder is concerned, the production is estimated through a potential production based on land use statistics data of the state for the year 2018-19 and presented in Table 3.10. It is pertinent to mention here that we have used area under fodder crop data from *Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare,*

Govt. of India, New Delhi instead of *Directorate of Animal Resources and Animal Husbandry, Government of West Bengal* as discussed in section I.4.1 in Chapter-I. It can be seen from the table 3.10 that estimated total availability of green fodder in West Bengal is 2.29 million tonnes only.

So far as availability of dry fodder and concentrates are concerned the estimation is done using crop production data for 2018-19 and conversion factors (HI & ER) as per FAO standards as mentioned in the methodology section (Table 1.13). The crop residues of different crops form a part of dry fodder consumed by the livestock. These crop residues, oil cakes, grains, and brans and chunnies of various fodder related crops are estimated using the standard conversion factors supplied by the coordinating centre. The estimated figures are presented in Table 3.11. A perusal of the table reveals that the main crop residues available for livestock in West Bengal are paddy, pulses, maize, wheat and groundnut; whereas main sources of oil cakes are rape-seed and mustard, sunflower and groundnut. Major sources of grains (as feed) are rice and maize whereas that of brans and chunnies is rice, pulses and wheat. The estimated figures of crop residues, oil cakes, grains, and brans and chunnies used as dry fodder and concentrates in West Bengal are 27.14 million tonnes, 1.35 million tonnes, 0.51 million tonnes, and 1.34 million tonnes, respectively. The crop residues are considered as dry fodder, whereas oil cakes, grains, brans and chunnies of major crops are considered as concentrates. Therefore, the estimated availability of dry fodder in West Bengal is 27.14 million tonnes, and that of concentrates is 3.10 million tonnes.

Availability of feed and fodder in terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) are also estimated from the availability of green fodder, dry fodder and concentrates using the suitable conversion factors as described in methodology section. Dry matter content in green fodder, dry fodder, and concentrates are estimated using a conversion factor of 0.25, 0.90 and 0.90, respectively. The factors for conversion 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 from each source into crude protein (CP) are taken as 0.073, 0.016 and 0.180 for green fodder, dry fodder and concentrate feed, respectively. Accordingly, total availability of DM, TDN, and CP is estimated at 27.87 million tonnes, 16.63 million tonnes, and 1.18 million tonnes, respectively (Table 3.12).

Table 3.11: Availability of Dry Fodder and Concentrates in West Bengal (Estimated)

SN	Crops	Production ('000 metric tonnes)	Conversion factors in terms of HI and ER used in the calculation of feed resources such as crop residues, oil cakes, grains, brans and chunnies							
			Harvest indices (HI)*				Extraction Rate(ER)			
			Crop residues*	Total ('000 tonne)	Oil Cakes*	Total ('000 tonne)	Grains*	Total ('000 tonne)	Brans and Chunnies*	Total ('000 tonne)
1	Paddy	16242.21	1.30	21114.87	-	-	0.02	324.84	0.08	1299.38
2	Wheat	337.79	1.00	337.79	-	-	0.02	6.76	0.08	27.02
3	Sorghum	0.00	2.50	0.00	-	-	0.05	0.00	-	-
4	Bajra	0.03	2.50	0.07	-	-	0.05	0.00	-	-
5	Barely	1.01	1.30	1.31	-	-	0.10	0.10	-	-
6	Maize	1732.87	2.50	4332.18	-	-	0.10	173.29	-	-
7	Ragi	2.93	2.00	5.86	-	-	0.05	0.15	-	-
8	Small Millets	4.61	2.50	11.53	-	-	0.10	0.46	-	-
9	Other Cereals	0.03	2.00	0.06	-	-	0.10	0.00	-	-
10	Pulse	368.40	1.70	626.29	-	-	-	-	0.03	11.05
11	Groundnut	187.95	2.00	375.90	0.70	131.57	-	-	-	-
12	Oil Seeds	1741.48	-	-	0.70	1219.03	-	-	-	-
13	Sugarcane	1335.37	0.25	333.84	-	-	-	-	-	-
	Total	**-**	**-**	**27139.69**	**-**	**1350.60**	**-**	**505.60**	**-**	**1337.45**

*Conversion factors are the ratio of tonnes of utilized crop by-product to tonnes of primary crop harvested.

Data Source: State crop area statistics (2018-19), Directorate of Economics & Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India, New Delhi.

Table 3.12: Availability of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) in West Bengal

Feed Type	Fresh Availability (Million Tonnes)	Conversion factors			Estimated Availability (Million Tonnes)		
		DM	TDN	CP	DM	TDN	CP
Green Fodder	2.29	0.25	0.534	0.073	0.57	1.22	0.17
Dry Fodder	27.14	0.90	0.476	0.016	24.43	12.92	0.43
Concentrates	3.19	0.90	0.780	0.180	2.87	2.49	0.57
Total	**32.62**	**-**	**-**	**-**	**27.87**	**16.63**	**1.18**

III.7: Feed and Fodder Requirement in West Bengal

III.7.1: Feed and Fodder Requirement in West Bengal (as per the FAO standards)

In order to estimate the feed and fodder requirement in West Bengal as per FAO standards, the 20th Livestock Census (2019) data is considered to find out the Ruminant Livestock Unit (RLU) in the state. The total feed and fodder requirement has been estimated by converting the livestock population in to RLU which is in accordance with FAO (2012) and Ramachandra et al (2007). The details of the methodology are discussed in section 1.8.2.1.2.

It is to be noted here that as per FAO standards, feed and fodder requirements are estimated in terms of dry matter requirements instead of separately for green fodder, dry fodder and concentrates. Further there is no estimate for requirements for total digestible nutrients (TDN) and crude protein (CP). Therefore, requirements are estimated only in terms of dry matter. Estimated dry matter requirement in West Bengal is presented in Table 3.13. A perusal of the table shows that daily dry matter requirement in the state is 92.45 thousand tonnes, whereas the annual demand is estimated at 33.74 million tonnes. Cattle constitute as much as 86.72 per cent of total demand for dry matter in the state. The total dry matter requirement for cattle, buffalo, goat and sheep are estimated at 29.26, 1.44, 2.88 and 0.17 million tonnes per annum, respectively.

Table 3.14 shows the availability and requirements of dry matter in West Bengal. Total dry matter required by the livestock in the state is estimated at 33.74 million tonnes and the availability of total dry matter is estimated at 27.87 million tonnes. So far as deficit and gap in dry matter availability is concerned, there is an annual deficit of 5.87 million tonnes of dry matter in West Bengal which constitutes 17.40 per cent of total requirement.

Table 3.13 Total Feed and Fodder Requirement in West Bengal (as per FAO Standards)

Particulars/ Age Groups	No of animals	Conversion factor for RLU	Dry matter requirements			
			Kg/animal/day	Kg/animal/ year	Total (Thousand Tonnes/ Day)	Total (Million Tonnes/ year)
Cattle (Indigenous + Crossbred)						
Under 1 year	5878169	0.11	0.77	281	4.53	1.65
1 to 2.5 year	3627592	0.34	2.38	869	8.63	3.15
Over 2.5 years	9572155	1.00	7.00	2555	67.01	24.46
All Cattle	**19077916**	**-**	**-**	**-**	**80.16**	**29.26**
Buffalo						
Under 1 year	123763	0.17	1.19	434	0.15	0.05
1 to 2.5 year	57977	0.50	3.50	1278	0.20	0.07
Over 2.5 years	449181	1.14	7.98	2913	3.58	1.31
All Buffalo	**630921**	-	-	-	**3.93**	**1.44**
Goat						
Under 1 year	7164927	0.03	0.21	77	1.50	0.55
Over 1 year	9114393	0.10	0.70	256	6.38	2.33
All Goat	**16279320**	**-**	**-**	**-**	**7.88**	**2.88**
Sheep						
Under 1 year	426157	0.03	0.21	77	0.09	0.03
Over 1 year	526733	0.10	0.70	256	0.37	0.13
All Sheep	**952890**	-	-	-	**0.46**	**0.17**
Others						
All Others	**1970**	0.25	1.75	639	**0.00**	0.00
All Livestock						
Overall	**36943017**	**-**	**-**	**-**	**92.45**	**33.74**

Note: No of animals as per latest census (20th livestock census, 2019); *Others includes horse, ponnies, donkey, mule, mithun, and yak.

Table 3.14: Dry Matter Requirement and Availability in West Bengal (As per FAO standards)

Feed Type	Dry Matter Requirement (MT)	Availability (MT)			Surplus (+)/Deficit(-) (MT)	Gap (%)
		Feed and Fodder (Fresh)	Conversion Factor	Dry Matter		
Green Fodder		2.29	0.25	0.57		
Dry Fodder		27.14	0.90	24.43		
Concentrates		3.19	0.90	2.87		
Total	**33.74**	**32.62**	**-**	**27.87**	**-5.87**	**17.40**

III.7.2: Feed and Fodder Requirement in West Bengal (as per the NATP standards)

The total requirement of feed and fodder, as per the NATP standards, in the state of West Bengal during 2019 is presented in Table 3.15. While NATP standards are provided only for four categories of cattle and buffalo (i.e., in-milk, dry, adult male, and young stocks), the Livestock Census data is available in six categories for male cattle (up to 1 and half years, used for breeding only, used for agriculture, used for both agriculture and breeding, used for bullock cart and farm operation, and others); six categories for female cattle (i.e. in-milk, dry, not even calved once, under 1 year, 1-2.5 years, and others); six categories for male buffalo (i.e. up to 2 years, used for breeding only, used for agriculture, used for both agriculture and breeding, used for bullock cart and farm operation, and others); and six categories for female buffalo (i.e. in-milk, dry, not even calved once, under 1 year, 1-3 years, and others). Therefore, in order to include all the categories, necessary adjustment is made here to covert 24 (6x4) different categories into four. Bovines under the category 'Not even calved once' as well as ''Others' are included within 'Dry' category, where as that of 'Under 1 Year', 'Up to 1.5 Years', 'Up to 2 Years', '1-2.5 Years', and '1-3 Years' for both male and female are included within 'Young Stocks'. Further, we have included horse, ponnies, mules, donkey, camel, mithun and yak but not pig under other categories of animal for the purpose of estimating feed and fodder requirement.

A perusal of the table reveals that as per NATP standards, daily requirement for green fodder, dry fodder and concentrates for livestock feed and fodder in the state is 81.48 million kgs, 77.10 million kgs, and 7.80 million kgs, respectively. The annual requirement for green fodder in West Bengal is 29.74 million tonnes, while annual dry fodder requirement is 28.14 million tonnes and that of concentrate is 2.85 million tonnes.

Table 3.15: Total Feed and Fodder Requirement in West Bengal (as per the NATP Standards)

Animal Category	Number of animals	Green Fodder		Dry Fodder(Kg)		Concentrates(Kg)	
		(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)
Cattle (Indigenous + Crossbred)							
In milk (Female)	46,10,216	4.75	21898526	5.50	25356188	0.64	29,50,538
Dry (Female)	26,62,365	3.40	9052041	4.02	10702707	0.40	10,64,946
Adult male	22,99,574	4.06	9336270	6.03	13866431	0.33	7,58,859
Young stock (Both male and female)	95,05,761	2.18	20722559	2.13	20247271	0.18	17,11,037
Buffalo							
In milk (Female)	1,41,581	5.96	843823	6.34	897624	1.05	1,48,660
Dry (Female)	51,562	5.44	280497	4.95	255232	0.52	26,812
Adult male	2,56,038	4.04	1034394	7.47	1912604	0.36	92,174
Young stock (Both male and female)	1,81,740	2.29	416185	2.22	403463	0.19	34,531
Goat, Sheep & Others							
Goat	162,79,340	1.04	16930514	0.20	3255868	0.06	9,76,760
Sheep	9,52,890	1.01	962419	0.20	190578	0.04	38,116
Others*	1,970	2.35	4630	6.72	13238	0.49	965
All Livestock							
Daily Requirement (in Kgs)	36943037	-	81481857	-	77101204	-	7803399
Annual Requirement (Million Tonnes)	**36.94 millions**	**-**	**29.74**	**-**	**28.14**	**-**	**2.85**

Note: No of animals as per latest census (20th livestock census, 2019); *Others includes horse, ponnies, donkey, mule, mithun, and yak.

Bulk of the feed requirement, as expected, came from cattle. The share of cattle in the total livestock population in West Bengal is 50.92 per cent, but it accounted for 91.01 per cent of dry fodder, 83.11 percent of concentrate, and 74.87 per cent of the green fodder requirement in the state. Buffaloes require about 3.16 per cent green fodder, 4.50 per cent dry fodder, and 3.87 per cent concentrate feed requirement in the state. Though the share of goat in total livestock population in the state is as high as 43.44 per cent, its share in the total requirement of feed and fodder is only 4.22 per cent of dry fodder, 12.52 per cent of concentrate, and 20.78 per cent of green fodder in West Bengal.

Based on feed availability and requirement as estimated using NATP standards, Table 3.16 presents the summary statement of aggregate availability, requirement, deficit and percentage gap in green fodder, dry fodder and concentrates in West Bengal. A perusal of the table reveals that there is severe shortage of green fodder in the state. The state is deficit in both green fodder and dry fodder but surplus in concentrates. However, the deficit in green fodder is acute. The state falls short by 27.45 million tonnes of green fodder which is as high as 92.30 per cent of its total requirement. This is a matter of serious concern. The magnitude of deficit in dry fodder is 1.00 million tonnes (3.55 per cent of requirement), and in concentrate feed the state is surplus by only 0.34 million tonnes (11.93 per cent of requirements). Overall, the feed –fodder deficit in the state is 28.11 million tonnes which is as high as 46.29 per cent of total requirements.

Table 3.16: Feed and Fodder Requirement and Availability in West Bengal (As per NATP standards)

Feed Type	**Requirement (MT)**	**Availability (MT)**	**Surplus (+)/Deficit(-) (MT)**	**Gap (%)**
Green Fodder	29.74	2.29	-27.45	92.30
Dry Fodder	28.14	27.14	-1.00	3.55
Concentrates	2.85	3.19	+0.34	(-)11.93
Total	**60.73**	**32.62**	**28.11**	**46.29**

An attempt is also made to estimate feed and fodder requirements in West Bengal in terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) requirements following NATP standards as explained in the methodology section. There are different formulas to estimate DM, TDN and CP requirements.

Table 3.17: Total Feed and Fodder Requirement in West Bengal in terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) (As per NATP standards)

Animal Category	Number of animals	DM (Kg)		TDN (Kg)		CP (Kg)	
		(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)
Cattle (Indigenous + Crossbred)							
In milk (Female)	46,10,216	6.71	30934549	3.44	15859143	0.27	12,44,758
Dry (Female)	26,62,365	4.83	12859223	2.46	6549418	0.18	4,79,226
Adult male	22,99,574	6.74	15499129	3.36	7726569	0.21	4,82,911
Young stock (Both male and female)	95,05,761	2.62	24905094	1.33	12642662	0.10	9,50,576
Buffalo							
In milk (Female)	1,41,581	8.14	1152469	4.25	601719	0.37	52,385
Dry (Female)	51,562	6.28	323809	3.21	165514	0.25	12,891
Adult male	2,56,038	8.06	2063666	3.99	1021592	0.24	61,449
Young stock (Both male and female)	1,81,740	2.74	497968	1.39	252619	0.10	18,174
Goat, Sheep & Others							
Goat	162,79,340	0.49	7976877	0.27	4395422	0.03	4,88,380
Sheep	9,52,890	0.46	438329	0.24	228694	0.03	28,587
Others*	1,970	7.08	13948	3.54	6974	0.22	433
All Livestock							
Daily Requirement (in Kgs)	36943037	-	96665061	-	49450324	-	3819770
Annual Requirement (Million Tonnes)	**36.94 millions**	**-**	**35.28**	**-**	**18.05**	**-**	**1.39**

Note: No of animals as per latest census (20th livestock census, 2019); *Others includes horse, ponnies, donkey, mule, mithun, and yak.

In this study we have used two different estimates NATP-I & NATP-II. NATP-I estimates are based on species-wise and age-group wise requirements as given in Table-1.15. NATP-II estimates are indirectly calculated using the conversion factors as explained in section 1.8.2.1.1 and supplied by the coordinating centre in revised table formats using the conversion factors used in Table 3.12. NATP-I estimates are presented in Table 3.17 while that of NATP-II is given in Table-3.18. A perusal of the table 3.17 reveals that the total annual requirement for DM in West Bengal (as per NATP-I estimates) is 35.28 million tonnes and that of TDN is 18.05 million tonnes and crude protein requirement is estimated at 1.39 million tonnes.

Table 3.18: Feed and Fodder Requirement and Availability in Terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) in West Bengal (As per NATP standards)

Feed Type	Requirements (MT)			Availability (MT)			Surplus (+)/Deficit(-) (MT)		
	DM	TDN	CP	DM	TDN	CP	DM	TDN	CP
Green Fodder	7.44	15.88	2.17	0.57	1.22	0.17	6.86	14.66	2.00
Dry Fodder	25.33	13.39	0.45	24.43	12.92	0.43	0.90	0.48	0.02
Concentrates	2.57	2.22	0.51	2.87	2.49	0.57	-0.31	-0.27	-0.06
Total (NATP I)	**35.28**	**18.05**	**1.39**	**27.87**	**16.63**	**1.18**	**7.41**	**1.42**	**0.11**
Total (NATP II)	**35.33**	**31.50**	**3.13**				**7.46**	**14.87**	**1.96**

Note: NATP I=As per NATP standards given in Table 1.15
NATP II= As per conversion factors described in section 1.8.2.1.1 (Table format supplied by the coordinating centre)

Table 3.18 shows the annual gap (deficit/surplus) in feed and fodder availability vis-à-vis their requirements in West Bengal in terms of DM, TDN and CP. A perusal of the table reveals that, in terms of NATP-II standards, requirements for DM, TDN and CP are much higher than their availability. There is a huge deficit for TDN (14.87 million tonnes). But as per NATP-I standards, the state is more or less self sufficient in CP as well as TDN requirements, though there is deficit in terms of DM (7.41 million tonnes). This difference is mainly because of acute scarcity of green fodder, near self sufficiency in dry fodder, and surplus in concentrates in the state.

III.7.3: Feed and Fodder Requirement in West Bengal (as per the Field Survey)

During our course of investigation, we find that actual amount of feed and fodder fed to different species of livestock is slightly different from the NATP standards. The NATP standards are average for whole of the country and are available only for four different

categories of cattle and buffaloes. However, actual feeding practices differ across the regions as well as livestock species; breed types (exotic or indigenous), stages of life, feeding practices, age and sex of the animal. Therefore, we made an attempt also to estimate feed and fodder requirement in West Bengal based on actual feeding practices in the state using more disaggregated feeding practices. The results are presented in Table 3.19. A perusal of the table reveals that as per Field Survey standards, daily requirement for green fodder, dry fodder and concentrates for livestock feed and fodder in the state is 79.01 million kgs, 99.51 million kgs, and 10.62 million kgs, respectively. The annual requirement for green fodder in West Bengal is 28.84 million tonnes, while annual dry fodder requirement is 36.32 million tonnes and that of concentrate is 3.87 million tonnes.

Bulk of the feed consumption, as expected, came from indigenous cattle. The share of indigenous cattle in the total livestock population in West Bengal is 41.84 per cent, but it accounted for 75.75 per cent of dry fodder, 63.25 percent of green fodder, and 59.86 per cent of the concentrate feed requirement in the state. Crossbred cattle which accounts for 9 per cent of 9.04 per cent of total livestock population in the state, requires 10.92 per cent of green fodder, 13.29 per cent of dry fodder, and 16.12 per cent of concentrate feed demand in the state. Buffaloes require about 2.92 per cent of green fodder, 3.15 per cent of dry fodder, and 2.89 per cent of concentrate feed requirement in the state. Though the share of goat in total livestock population in the state is as high as 43.44 per cent, its share in the total requirement of feed and fodder is 7.62 per cent of dry fodder, 20.79 per cent of concentrate, and 21.69 per cent of green fodder in West Bengal.

This pattern of daily feed intake by different categories of livestock in the study area was as expected. Within a livestock category, feed consumption is also influenced by animal's age, sex, function, as well as feeding practices. Higher feeding rates for in-milk animals are expected because of their additional energy requirement for the production of milk and reproduction. Similarly, higher feeding rates for adult males used for transport and farming operations are obvious for their higher energy requirements to perform various agricultural operations which are strenuous in nature. Small ruminants like goat and sheep normally do not perform any strenuous activities and thus their feeding rates are much lower.

Table 3.19: Total Feed and Fodder Requirement in West Bengal (As per Field Survey standards)

Animal Category	Number of animals	Green Fodder		Dry Fodder(Kg)		Concentrates(Kg)	
		(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)	(Kg per animal)	Total (Kg)
Crossbred Cattle (Female)							
Under 1 year	8,25,099	0.51	420800	1.45	1196394	0.19	1,56,769
1 to 2.5 year	6,51,029	2.34	1523408	3.68	2395787	0.54	3,51,556
In-milk	10,43,096	4.12	4297556	5.53	5768321	0.80	8,34,477
Dry	3,33,358	3.61	1203422	6.19	2063486	0.50	1,66,679
Not even calved once	119140	4.02	478943	5.48	652887	0.87	1,03,652
Others	45,728	0.78	35668	1.87	85511	0.20	9,146
Crossbred Cattle (Male)							
Up to 1.5 Years	245192	0.64	156923	1.66	407019	0.20	49,038
Used for breeding only	27391	4.15	113673	5.12	140242	0.25	6,848
Used for agriculture only	64648	4.30	277986	5.35	345867	0.33	21,334
Used for both breeding and agriculture	12396	4.55	56402	5.75	71277	0.35	4,339
Used for bullock cart and farm operation	11747	4.65	54624	5.95	69895	0.38	4,464
Others	14328	0.78	11176	1.87	26793	0.20	2,866
Indigenous Cattle (Female)							
Under 1 year	32,33,170	1.19	3847472	1.99	6434008	0.15	4,84,976
1 to 2.5 year	29,76,563	3.02	8989220	5.84	17383128	0.35	10,41,797
In-milk	35,67,120	4.60	16408752	5.74	20475269	0.69	24,61,313
Dry	14,95,776	4.53	6775865	6.47	9677671	0.50	7,47,888
Not even calved once	4,77,127	4.51	2151843	6.19	2953416	0.56	2,67,191
Others	1,91,236	4.17	797454	5.67	1084308	0.35	66,933
Indigenous Cattle (Male)							
Up to 1.5 year	1574708	1.19	1873903	1.99	3133669	0.15	2,36,206
Used for breeding only	191752	4.02	770843	6.20	1188862	0.45	86,288
Used for agriculture only	1590808	4.20	6681394	6.62	10531149	0.49	7,79,496
Used for both breeding and agriculture	132593	4.38	580757	6.88	912240	0.50	66,297
Used for bullock cart and farm operation	128732	4.44	571570	6.94	893400	0.54	69,515
Others	125179	4.17	521996	5.67	709765	0.35	43,813

Buffalo (Female)							
Under 1 year	63994	0.85	54395	1.20	76793	0.21	13,439
1 to 3 year	57977	2.45	142044	3.90	226110	0.25	14,494
In-milk	141581	5.05	714984	6.83	966998	1.12	1,58,571
Dry	32883	4.57	150275	5.53	181843	0.51	16,770
Not even calved once	12,881	3.74	48175	5.21	67110	0.27	3,478
Others	5,798	3.79	21974	5.87	34034	0.32	1,855
Buffalo (Male)							
Up to 2 year	59769	1.15	68734	2.58	154204	0.23	13,747
Used for breeding only	16528	4.20	69418	5.25	86772	0.30	4,958
Used for agriculture only	192563	4.30	828021	5.55	1068725	0.33	63,546
Used for both breeding and agriculture	16701	4.50	75155	5.60	93526	0.34	5,678
Used for bullock cart and farm operation	23112	4.65	107471	5.75	132894	0.35	8,089
Others	7134	3.60	25682	5.35	38167	0.32	2,283
Goat (Female)							
Under 1 year	4407562	0.78	3437898	0.33	1454495	0.10	4,40,756
In-milk	3362303	1.20	4034764	0.57	1916513	0.17	5,71,592
Dry	2205508	1.16	2558389	0.52	1146864	0.15	3,30,826
Not even calved once	724211	1.16	840085	0.52	376590	0.15	1,08,632
Goat (Male)							
Under 1 year	2757365	0.86	2371334	0.37	1020225	0.10	2,75,737
1 Years and above	2822371	1.38	3894872	0.59	1665199	0.17	4,79,803
Sheep	952890	1.01	962419	0.20	190578	0.04	38,116
Others*	1970	2.35	4630	6.72	13238	0.49	965
All Livestock							
Daily Requirement (in Kgs)	36943017	-	79012368	-	99511241	-	10616213
Annual Requirement (Million Tonnes)	**36.94 millions**	**-**	**28.84**	**-**	**36.32**	**-**	**3.87**

Note: No of animals as per latest census (20th livestock census, 2019); In case of Sheep and Others we used NATP standards; *Others includes horse, ponnies, donkey, mule, mithun, and yak.

As compared to NATP standards, actual feed consumption rates in the study area are slightly lower for green fodders but significantly higher for dry fodder and concentrates. This is because of acute shortages of green fodder in the state. In rural areas, indigenous cattle are mostly fed with natural grazing and paddy straw supplemented by cooked grains and mustard oil cakes. In urban and peri-urban areas, bovine farming is mainly for milk production. The dairy farmers in these areas mainly rear cross bred cattle and buffaloes with stall feeding practices. The energy requirements for these cattle are mostly met with dry fodder (chaffed paddy straw) and different types of concentrate feed. Goat which is another very important livestock in West Bengal with fastidious eating and browsing habit, are mostly managed by both grazing (in rural areas) and stall feeding (in urban and peri-urban areas). Goat thrives on a variety of feed including agricultural by-products or household wastes which are generally avoided by other livestock. They are also fed with harvested natural grasses, available shrubs and lopped tree leaves. For yielding more milk and high quality meat, the goats are often provided with concentrate mixture and leguminous fodder in their diet along with vitamin and mineral supplements.

Fig 3.1: Feed and Fodder Availability vs. Requirement in West Bengal

(In Million Tonnes/Annum)

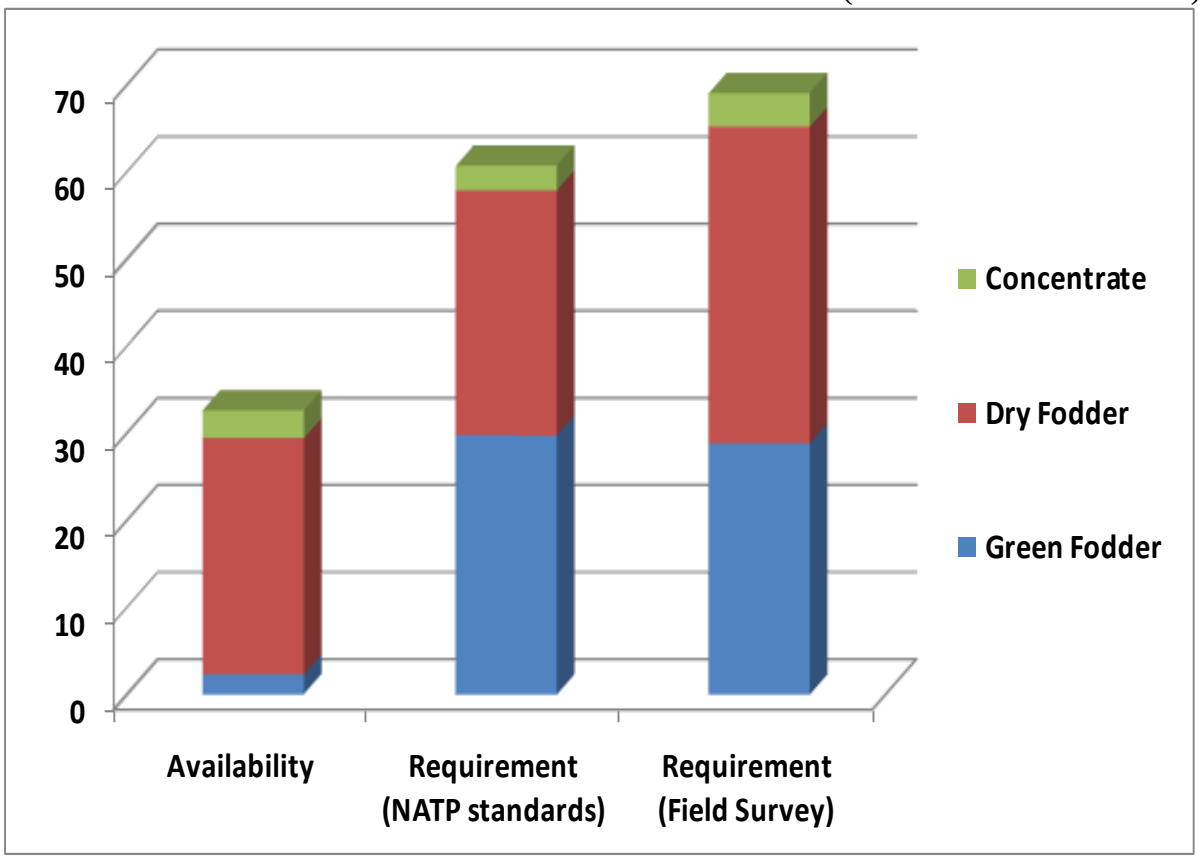


Fig 3.2: Feed and Fodder Availability vs. Requirement in West Bengal in Terms of DM, TDN and CP

(In Million Tonnes/Annum)

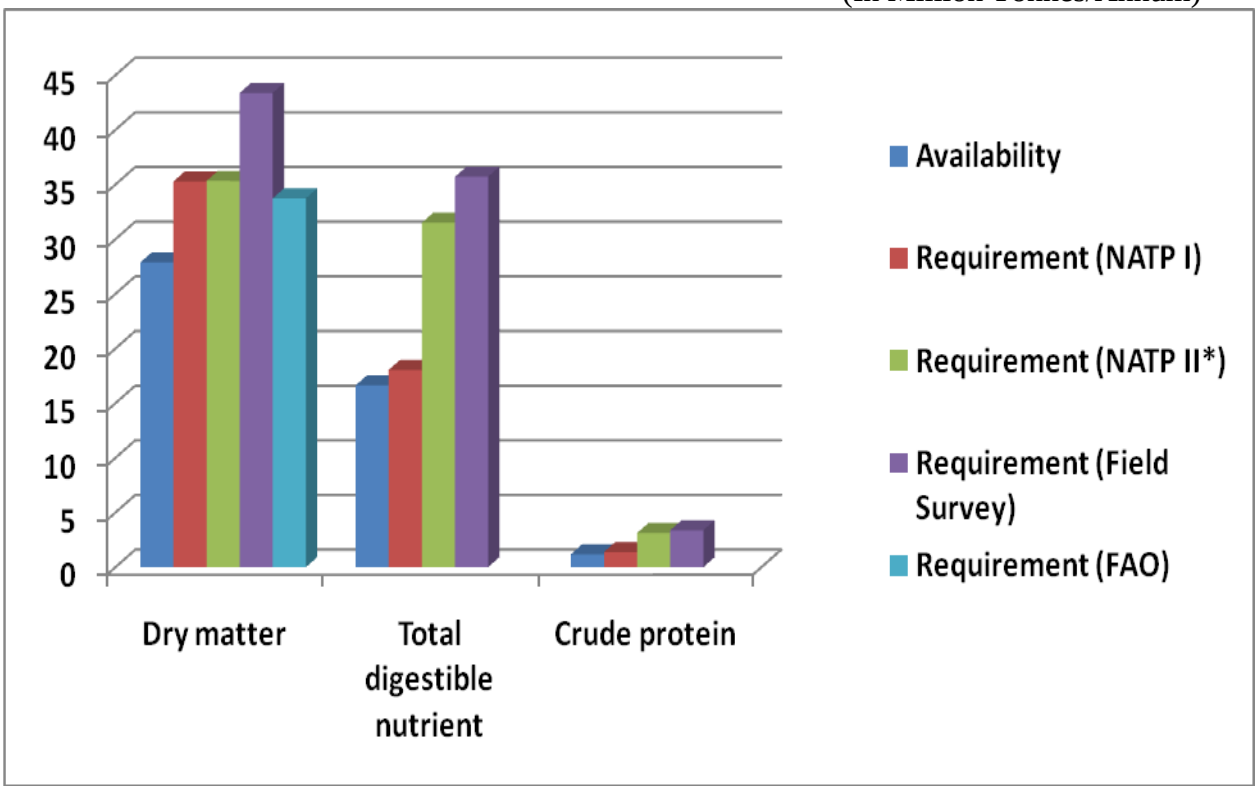


Table 3.20: Feed and Fodder Requirement and Availability in West Bengal (As per Field Survey)

Feed Type	Requirement (MT)	Availability (MT)	Deficit (MT)	Gap (%)
Green Fodder	28.84	2.29	26.55	92.06
Dry Fodder	36.32	27.14	9.18	25.28
Concentrates	3.87	3.19	0.68	17.57
Total	**69.03**	**32.62**	**36.41**	**52.75**

Table 3.21: Feed and Fodder Requirement and Availability in Terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) in West Bengal (As per Field Survey)

Feed Type	Requirements (MT)			Availability (MT)			Surplus (+)/Deficit(-) (MT)		
	DM	TDN	CP	DM	TDN	CP	DM	TDN	CP
Green Fodder	7.21	15.40	2.11	0.57	1.22	0.17	6.64	14.18	1.94
Dry Fodder	32.69	17.29	0.58	24.43	12.92	0.43	8.26	4.37	0.15
Concentrates	3.48	3.02	0.70	2.87	2.49	0.57	0.61	0.53	0.12
Total	**43.38**	**35.71**	**3.38**	**27.87**	**16.63**	**1.18**	**15.51**	**19.08**	**2.21**

Feed and fodder gap in the state, based on actual feeding practices in our study area, is presented in Table 3.20. A perusal of the table shows that, as compared to NATP standards, the estimated feed and fodder requirements in West Bengal is slightly lower for green fodder but significantly higher for dry fodder and concentrates. This is because of acute shortages of green fodder in the state where farmers compensate the green fodder requirement with paddy straw and purchased concentrate feed. Based on actual feeding practices, the state falls short by 26.55 million tonnes of green fodder which is as high as 92.06 per cent of its total requirement. The magnitude of deficit in dry fodder is 9.18 million tonnes (25.28 per cent of requirement), and in concentrate feed is 0.68 million tonnes (17.57 per cent of requirements). So far as availability and requirements of feed and fodder in terms of DM, TDN and CP is concerned, a similar kind of scenario exists across different standards (Fig.-3.2). On an average, the state could produce less than half (47.25 per cent) of its feed requirement (Table 3.20 & 3.21). This is a matter of serious concern for the development of livestock sector in West Bengal as the quantity and quality of feed resources are the primary drivers to maximize the livestock production and productivity.

III.8: Major Sources of Livestock Feed

The major sources of livestock feed as reported by the sample households in West Bengal are presented in Table 3.22. The table indicates that crop residues is the main source of livestock feed for all the sample households in West Bengal. Almost the entire quantity of dry fodder came from the cultivated crops, mainly from paddy straws. The next important source of livestock feed is household left over. This is particularly common for goat and indigenous cattle together which constitute 85 per cent of the total livestock population. This is followed by improved forage and pasture, and tree legumes grown as hedge.

Table 3.22: Major Sources of Livestock Feed

Source of Livestock Feed	Number of households reported	
	Number	*Percent*
Grazing land	39	26
Crop residues	150	100
Improved forage and pasture	111	74
Household left over	125	83
Tree legumes grown as hedge or any	100	67
Feed preservation and storage	3	2

Source: ***Field survey***

It is encouraging to find that seventy four per cent of sample households (i.e. 111 out of 150) are going for improved forage and pastures in course of livestock rearing. Only 26 per cent of sample households depend on grazing lands. However, only 2 per cent of the sample households depend on feed preservation and storage. It appears that despite their relatively low economic position the household are trying their best to carry forward the enterprise of animal husbandry.

III.9: Details of Sheds and Fodder Storages

Animal rearers' low economic profile in general poses much hindrance towards their enterprise is quite visible when we look into the cattle sheds they maintain for their animal stock. It is unfortunate that over eighty nine per cent of the cattle and buffalo rearers' are keeping their cattle under kutchha shed (132 out of 147, i.e. 89.7 per cent) made up mostly with mud walls and straw thatched roof (Table 3.23) averaging a total cost of INR 13,008 only. Even in some cases during the course of our survey we did not find proper cattle shed being maintained by the household. In case of goats (no sheep being reared by the responding farmers), more than 75 per cent sample household (92 out of 120 goat rearer) do not have any kind of shed and they keep the goat along with family members for night shelter as well as during inclement weather. Only 23 per cent of sample households have some kind of shed all of which are open kachcha shed with only roof and little side walls mostly covered with gunny bags, bamboo, paddy straw, tree leaves, earthen tiles, etc. Average cost of such shelters is very meager (INR 2,029). Pucca shed for keeping livestock are not very common in these districts. However, only 10.3 per cent of the households could afford to have a pucca cattle shed with an average cost of INR 148000. In a small farm dominant economy the feature seems quite trivial.

Table 3.23: Details about cattle shed

(In number & average value in INR)

Particulars	Pucca		Kachcha		Mixed	
	Number	Average value	Number	Average value	Number	Average value
Buffalo and Cattle shed	15	1,48,000	132	13,008	-	-
Sheep and Goat shed	-	-	28	2029	-	-

Source: ***Field survey***

III.10: Details of Labour and Maintenance Charges

It is a well known fact that animal husbandry in general and cattle rearing in particular is a labour intensive enterprise. Hence, labour requirement seems to account for a substantial amount of cost (Table 3.24). Average labour requirement, per day per animal, is worked out as 0.93 hours for buffalo, 1.03 hours for both indigenous and cross bred cattle, and 0.11 hours for goat. It is important to note here that these enterprises are primarily run by the family members. While indigenous cattle and goat is maintained mostly by the female members of the family, involvement of male members are more for buffalo and crossbred cattle. This is particularly because buffalo and crossbred cattle are mostly reared as a commercial enterprise while goat and indigenous cattle as subsistence farming. However, if we impute the market value of labour (i.e. ruling wage rate) we are faced with a situation where labour cost becomes the principal component (next to feed cost) of total cost of rearing ranging from 36.06 per cent to 47.91 per cent. Feed and fodder cost is the most important items of cost ranging from 45.21 per cent to 60.39 per cent in total cost of rearing. Together they constitute as high as 93.12 per cent to 96.45 per cent in the total cost of rearing. Other important component appears to be the veterinary medical expense maintenance costs incurred by the household. Average veterinary cost and maintenance costs are highest for crossbred cattle followed by buffalo and indigenous cattle. On the contrary goat rearing does not require much of veterinary costs or maintenance cost.

Table 3.24: Details of Labour and Other Maintenance Charges

Particulars		**Buffalo**	**Indigenous cattle**	**Crossbred Cattle**	**Goat**
Labour requirement (Hrs/day/animal)	Male (hrs)	0.65	0.41	0.63	0.03
	Female (hrs)	0.28	0.62	0.40	0.08
Labor cost* (INR/year/animal)	Male (INR)	9781.34	5734.18	9459.03	488.64
	Female (INR)	3692.07	9395.33	5354.40	1108.69
Veterinary Cost (INR/year/animal.)		1306.09	881.15	1500.82	76.08
Maintenance cost (Equipments, electricity and water charges. (INR./year/animal)		488.34	402.62	544.52	68.31
Feed and fodder Cost (INR/year/animal)		13588.95	15720.55	13979.5	2675.45
Any other cost (INR/year/animal)		65.64	42.09	80.54	12.97
Total (Rs./Year/Animal)		**28922.43**	**32175.92**	**30918.81**	**4430.14**
Share of labour cost in total (%)		46.58	47.02	47.91	36.06
Share of feed and fodder cost in total(%)		46.98	48.86	45.21	60.39

Source: ***Field survey*** *Converted 8 hours per day as a wage rate

III.11: Details of Returns from Livestock Reared

Returns from livestock realized by the sample households are presented in Table 3.25. Returns from livestock enterprise in West Bengal are mainly from the primary product milk. However, value added products of milk (e.g. ghee, butter, paneer, curd etc.) do have their own markets but the size of market for these products is relatively small as compared to the market for liquid milk. Moreover, there is severe shortage of large scale milk processing plants in the state. Further, majority of the cattle rearing households are poor with very small scale production and local rural markets for livestock products are thin, and it is difficult to sale at distant urban markets due to high transportation cost. Though there are milk co-operatives operating in many villages nonetheless these co-operatives function as a collection centre for liquid milk only. They do not have required infrastructure and technology for milk processing and producing value added items like ghee, paneer etc. Hence, the farmers in the villages prefer selling the liquid milk.

It can be seen from the Table 3.25 that the milk yield of crossbred is the highest (9.06 lit/day) liters, followed by buffalo (6.57 lit/day) and indigenous cattle (4.43 lit/day). However, in terms of price buffalo milk fetches higher return than that of crossbred cattle due to higher fat content in buffalo milk as compared to crossbred cow. Therefore, total revenue earned from sale of milk is highest for buffalo followed by crossbred and indigenous cattle. On the other hand, goat milk is not quite popular in the study area and accounted for only 0.69 lit/day among the sample households. Goat is mostly reared for meat purpose and sold as animal.

Dung sale is also an important part of cattle business in the villages. Dung is mostly used as manure in crop cultivation and has a good market in West Bengal. Farmers rearing buffalo are earning higher revenue from sale of dung. It is also apparent that buffalo (as animal) is costlier than the cattle be it crossbred or indigenous. The unit price (i.e. selling price) of a buffalo on an average is the highest (INR 36357.94) followed by crossbred cattle (INR 25582.83) and indigenous cattle (INR 19566.90). The main earning from goat comes from sale of the animal and on an average the selling price of a goat is INR 9795.52.

Table 3.25: Returns from Livestock Rearing (Average)

Particulars		Crossbred cattle	Indigenous cattle	Buffalo	Goat
Milk	Milk yield (Lit/day/animal)	9.06	4.43	6.57	0.69
	Lactation period (days/yr)	270	270	270	200
	Adjusted average milk yield (Lit/day/animal)	6.70	3.28	4.86	0.38
	Milk price (INR/lit)	31.45	30.96	45.10	30.88
	Yield (Lit/Year)	2445.05	1197.07	1774.46	138.75
	Revenue from milk (INR/year/animal)	76900.05	37056.70	80023.80	4285.23
Dung	Tonnes/year/animal	5.85	5.01	8.39	0.55
	Dung price (Rs./tonnes)	658.77	638.31	679.31	235.40
	Revenue from dung (INR/year/animal)	3850.28	3187.56	5680.00	130.14
Sales details of animal	Animal weight(Kgs)	130.52	89.68	155.52	18.33
	Number of animals (Number)	268	124	446	347
	Revenue from sale of animal (INR/animal)	25582.83	19566.90	36357.94	9795.52
Any other by-product specify	Kgs/animal	-	-	-	-
	Sales price (INR)	-	-	-	-

Source: ***Field survey*** Note: - Annual milk yield is converted from milk yield in a lactation period

It appears from the Table 3.25 that average productivity of livestock in West Bengal is quite low. This is perhaps because of feeding insufficient amount of green fodder and poor quality dry fodder (paddy straw) which contains very little amount of total digestible nutrients and crude protein. The productivity of indigenous cattle and goat is particularly low but together they constitute more than 85 per cent of total livestock population in the state. Therefore, it can be concluded that there are two distinct constraints to the development of livestock sector in West Bengal. One, predominance of indigenous breeds with low milk and meat productivity; and second serious constraints is acute shortages of feed and fodder in the state, particularly green fodder.

Chapter – IV

Constraints, Views and Suggestions Given by Sample Households for Fodder Cultivation

In this chapter we shall discuss about the constraints that are being faced by the farmers in their pursuit of animal husbandry, and suggestions given by them.

IV.1: Constraints Faced by the Sample Households for Fodder Cultivation

The constraints that are being faced by the livestock rearing farmers in their pursuit of fodder cultivation are presented in Table 4.1. As highlighted by all the surveyed farmers, during the interview process, non-availability of additional land to put under fodder crop is the most serious constraints. All the farmers unanimously acknowledged that average size of holding in the state is very low and household food requirement and profitability are the guiding force to allocate their scarce cultivable land in to different crops. The farmers are, therefore, not inclined to put their scarce land into fodder cultivation because of high cost and low returns from fodder cultivation compared to other competing crops. Lack of training facilities for fodder cultivation and poor livestock extension services provided by the Government are other important constraints faced by more than 90 per cent of the respondents. Also the lack of awareness about government subsidy scheme on fodder cultivation, as well as about fodder production and post harvest techniques in the state are important constrains faced by around three-fourth of surveyed farmers. Moreover, about 73 per cent (110 out of 150) surveyed farmers viewed non-availability of quality seed and high cost of fodder seeds as important constraints. Low price of green fodder, except during summer, in rural areas also act as an important hindrance in fodder cultivation for animal rearing activity. Further, there is no acute scarcity of land for cattle grazing in the study area. A little less than half (47.33 per cent) of sample farmers consider fodder cultivation as a laborious enterprise and complained about labour scarcity during peak period. Livestock rearing itself is a labour intensive activity, and is managed primarily with family labour. Given the dominance of small farm economy in the state, there is high dependence on family labour that supports our inference from the field level data. However, lack of irrigation or suitability of land is not at all perceived as a constraint so far as fodder cultivation is concerned. It is therefore apparent that the government financial and/or technical support for fodder and livestock development needs to be strengthened through its network of offices to achieve widespread coverage at the grass root level.

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

Constraints		Households reported	
		Number	*Percent*
1	Land is very less therefore cannot afford to put more land under fodder seed/crop production	150	100.00
2	Non availability of adequate irrigation water	-	-
3	Non availability of labour	64	36.00
4	Land is not suitable for fodder production	-	-
5	High Cost of Cultivation/Production and Low return on fodder production	150	100.00
6	Low price prevails for green fodder in market	105	70.00
7	High cost of fodder seed	110	73.33
8	Non availability of quality fodder seed in market	110	73.33
9	Availability of grazing lands	40	26.67
10	Lack of training facilities	137	91.33
11	Poor livestock extension services	136	90.67
12	Lack of awareness about government subsidy on fodder seeds	114	76.00
13	More laborious	54	36.00
14	Lack of awareness on production and post harvest techniques	112	74.67

Source: ***Field survey***

IV.2: Adoption of Post-Harvest Management for Fodder Crops

It has been observed that only 15.33 per cent sample farmers has adopted post-harvest techniques for fodder in the study area (Table 4.2). This is mainly due to their lack of awareness regarding post harvest management of fodder crops (Table 4.3). It is very unfortunate to note that as high as 127 sample households (84.67 per cent) has not adopted post harvest technique and out of them 112 sample households (88.19 per cent) are not even aware about any post harvest management technique for fodder crops. This indicates failure of the concerned extension mechanism in sensitizing and training and livestock farmers for such techniques. During our field survey, we found that given the training, many of the livestock farmers are interested in post harvest management of fodder (like silage, hay making, etc.). Only 7.87 per cent respondent considered it inferior in comparison to fresh fodder, and 3.94 per cent considered it both laborious and expensive. Therefore, it can be said that there is a felt need for training for the livestock farmers and fodder cultivators on various techniques for post harvest management of fodder crops. At the same time, there is also a need to popularize fodder cultivation and sensitize the farmers about benefits of green fodder and its post harvest management.

Table 4.2: Total Number of Farmers Adopted Post Harvest Techniques

Adopted Post Harvest Techniques	Yes	No
Number of households	23	127
Percentage of households	15.33	84.67

Source: ***Field survey***

Table 4.3: Major Reasons for Not Adopting Post Harvest Techniques

Particulars	Households reported	
	Number	*Percent*
Considered inferior in comparison to fresh one	10	7.87
Highly expensive	5	3.94
Lack of awareness on production and post harvest management	112	88.19
More laborious	5	3.94

Source: ***Field survey***

IV.3: Government Assistance for Livestock Rearing in the Study Area

There are several programmes of livestock development in the state through which the block livestock development officer (BLDO) is mandated to provide assistance to the farmers. Also there is block veterinary surgeon (VS) posted at the block level for advising the farmers. However, it is strange that 42.67 per cent household reported that they did not receive any kind of benefit (not even free advice) from government for livestock rearing (Table 4.4). In course of the present sample survey, it is found that the main benefit derived by the livestock farmers in the study area is free advice from the block veterinary surgeon. Forty four per cent livestock farmers did receive free advice from the veterinary surgeon posted at the block level mainly on livestock diseases. Only 13.33 per cent households have been provided with chaff-cutting machine free of cost by the BLDO and 8 per cent sample farmers received free vaccination and training. It is also found that only 3.33 per cent livestock farmers received benefits from artificial insemination (AI) programme. Although, a comprehensive centrally sponsored National Project for Cattle and Buffalo Breeding (NPCBB) has been launched in the State of West Bengal since 2001-02 and the 'Paschim Banga Go-sampad Bikash Sanstha' (PBGSBS) has been made the State Implementing Agency of this project, the state never reached the goal of artificial insemination. However, in order to enhance the share of improved livestock population, AI is very important. Therefore, adequate initiatives need to be taken by the authorities to improve the breeds through AI. The coverage under cattle insurance scheme too is as low as 1.33 per cent in the study area. None of the sample farmer received subsidy for cattle or cattle shed. The facts and figures discussed above suggest that

there is a deficiency of assistance for livestock development in the state considering the economic profile of the households practicing animal husbandry.

Table 4.4: Benefits getting from the government to livestock Production

SN	List of Benefits	Households reported	
		Number	*Percent*
1	Free advice from veterinary surgeon at the block office	66	44.00
2	Free Chaff-cutting machine from the office of BLDO	20	13.33
3	Training received on livestock rearing	12	8.00
4	Free medicine and vaccination	12	8.00
5	Facilities of artificial insemination (AI)	5	3.33
6	Cattle insurance	2	1.33
7	No benefit received	64	42.67
	Total	**150**	**100.00**

Source: ***Field survey***

IV.4: Suggestions Given by the Sample Households for Fodder Cultivation

Although fodder cultivation and post harvest management of fodder in the study area is not a common practice, more than 70 per cent respondents highlighted some suggestions to improve production of fodder related crops in the study area. As can be seen in the Table 4.5, the major suggestions made by the sample household are related to availability and price of quality fodder seed; and training on fodder cultivation and post harvest management. Around 35 per cent of the surveyed households are looking for improved fodder seeds to be made available at a subsidized rate, 31.3 per cent of the surveyed households want training on improved fodder cultivation and about 34.0 percent of the surveyed households also want training for post-harvest management of fodder crops. It appears from the responses that the farmers are eager to take up fodder cultivation and interested in learning post harvest management techniques of fodder crops.

Table 4.5: Major Suggestions to Improve Production of Fodder Related Crops

SN	List of Suggestions	Households reported	
		Number	*Percent*
1	Timely availability of improved fodder seed	55	36.67
2	Provision for subsidy on fodder seed	52	34.67
3	Provision of training for fodder cultivation	47	31.33
4	Provision of training for post-harvest management of fodder crops	51	34.00
5.	No suggestion given	43	28.67
	Total	**150**	**100.0**

Source: ***Field survey***

Chapter – V

Major Findings and Policy Suggestions

Livestock rearing plays a major role in supplementing family income and generating gainful employment, particularly among the landless laborers, small and marginal farmers, and especially women. But scarcity of feed and fodder is also a serious constraint for development of this sector in the state. Considering the magnitude of dependence on livestock sector in West Bengal in one hand, and low animal productivity on the other hand, the present study was undertaken to assess livestock feed and fodder resources for future growth of this sector. The study is based on both secondary information and primary survey. Primary survey was carried out in three districts of West Bengal, namely, North 24-Parganas, Burdwan and Murshidabad covering 120 sample farmers each for cattle, buffalo, and goat. The major findings of the study and policy recommendations are discussed in the following sections.

V.1: Major Findings of the Study

V.1.1 Growth Pattern of Major Livestock Population in West Bengal

1. The state of West Bengal is home to 37.48 million livestock which is 4th largest number in the country. Although, the state has fourth largest number of livestock in the country, most of them are indigenous (82.46 per cent) in nature which is one of the important constraints to boost up the productivity.

2. There are 19.08 million cattle in West Bengal which is 3rd in the country; 16.28 million goat which is 2nd in India, and about 77.32 million poultry which is 5th in India. There are nearly 220 bovines and 200 small ruminants for every 1000 human populations in the State.

3. Indigenous cattle and goat dominates the livestock sector in West Bengal, together they constitutes more than 85 per cent of total livestock population in the state. While cattle accounted for 50.92 per cent of total livestock in the state, goat accounted for as high as 43.44 per cent against the national average of 27.80 per cent only. The corresponding share of other livestock are 2.53 per cent for sheep, 1.68 per cent for buffalo, 1.44 per cent for pig and only 0.03 per cent for others like horse, donkey, mithun, mule, yak, etc.

4. However, it is encouraging that crossbred cattle have been increased by 21.33 per cent and that of female crossbred by a whopping 33.74 per cent during last 7 years. Total numbers as well as relative share of buffalo, sheep, pig and other livestock showed a declining trend during last five censuses.

5. Besides fish and rosgolla, West Bengal has an insatiable appetite for goat meat, chicken and eggs. Therefore, both goat and poultry farming represents a golden opportunity for off-farm livelihood diversification for unemployed youths in the state.

6. Production of egg is growing at an annual rate of 13.54 per cent per annum in West Bengal. The growth rate in meat production is also more than 5 per cent per annum. However, growth in milk production as well as milk yield in West Bengal is much lower than All India averages. Production of wool is very negligible in West Bengal.

V.1.2: Field Level Experiences from West Bengal

1. Rural people in West Bengal are highly dependent on mixed crop-livestock farming system for their livelihood where crossbred cattle and buffaloes are mostly reared with commercial motive for milk production and goat for mutton. Rearing indigenous cattle is an important part and parcel of subsistence farming in meeting both the requirement of milk and animal power for farming operations.

2. Livestock rearing in West Bengal is a highly labour intensive but profitable enterprise primarily run by the family members, particularly women. The imputed cost of family labour in the total cost of animal rearing ranges from 36.06 per cent to 47.91 per cent. Therefore livestock rearing plays a major role in supplementing their family income and generating gainful employment.

3. Goat rearing is very much profitable and has huge economic potentiality. Because of low rearing cost, low initial investment, early maturity (at the age of 10–12 months), short gestation period, and above all delicious meat and high quality skin, rearing Black Bengal breed of goat is very popular among the poor farmers of the state. They can efficiently survive on household waste, and available shrubs and trees.

4. There is severe feed and fodder scarcity at household level. On an average, the livestock farmers could produce only 40 per cent of their feed requirement. This is a

matter of serious concern as the quantity and quality of feed resources are the primary drivers to maximize the livestock production and productivity.

5. Most of the feed comes from agricultural residues with very limited availability of green fodder particularly during summer season. Acreage under fodder crop is only 4 per cent of the gross sown area, despite the fact that livestock farming is the primary occupation for 92 per cent of sample households.

6. Due to small farm dominated subsistence farming, farmers are not inclined to put their scarce land into fodder cultivation because of household requirement for staple food and low returns from fodder cultivation compared to other competing crops like potato and summer paddy. However, majority of livestock farmers are eager to take up fodder cultivation and interested in learning post harvest management techniques of fodder crops, but unable to do so due to lack of technical knowhow about fodder cultivation and post harvest management, non-availability of quality seed, low productivity, and high cost of fodder seeds.

7. As compared to NATP standards or FAO standards, actual feed consumption rates in the study area are slightly lower for green fodders but significantly higher for dry fodder and concentrates. This is because of acute shortages of green fodder in the state. Higher feeding rates for in-milk animals and adult males used for transport and farming operations are obvious due to their higher energy requirements for milk production, reproduction and strenuous farm operations.

8. In rural areas, indigenous cattle are mostly fed with natural grazing and paddy straw supplemented by cooked grains and mustard oil cakes. But in urban and peri-urban areas, energy requirements of cattle and buffalo are mostly met with dry fodder (chaffed paddy straw) and different types of concentrate feed. Goat thrives on a variety of feed including agricultural by-products or household wastes which are generally avoided by other livestock. They are also fed with available shrubs, lopped tree leaves, and concentrate mixture rich in vitamin and mineral supplements.

9. There are several programmes for livestock development in the state but very few sample livestock farmers in the study area actually benefited from such schemes. Main benefit derived by them is free advice from the block veterinary surgeon on livestock diseases. Only 8 per cent sample farmers received free vaccination and

training and a mere 3.33 per cent received benefits from artificial insemination (AI) programme. However, as high as 42.67 per cent household did not receive any kind of benefit, not even free advice.

V.1.3: Status of Availability and Requirement of Feed and Fodder

1. West Bengal is an acute fodder deficient state. It is partly due to non-availability of fodder land which is far below the all India average, and partly due to lack of adequate pasture and grazing land. Only 0.07 per cent of the total land is available for pasture and grazing in the state. Total area under fodder crops in West Bengal is only 3500 hectares which is less than 0.04 per cent of gross sown area as compared to a national average of 4.6 per cent.

2. Availability of feed ingredients is also bleak. Estimated availability of green fodder, dry fodder and concentrates in the state is 2.29 million tonnes, 27.14 million tonnes and 3.10 million tonnes, respectively. Availability of feed and fodder in terms of Dry Matter (DM), Total Digestible Nutrient (TDN), and Crude Protein (CP) are estimated at 27.87 million tonnes (MT), 16.63 million tonnes (MT), and 1.18 million tonnes (MT), respectively.

3. There exist a huge gap between availability and requirements of all types of feed resources, particularly, green fodder, dry fodder and in terms of TDN & CP. This is a matter of serious concern for the development of livestock sector as both the quantity and quality of feed resources are primary drivers to maximize the livestock production and productivity.

4. As per NATP standards, the state falls short by 27.45 MT of green fodder which is as high as 92.30 per cent of its total requirement and by 1.00 MT (3.55 per cent of requirement) of dry fodder. However, the state is self-sufficient in concentrate feed with a surplus of 0.34 MT (11.93 per cent of requirements). The deficit in terms of DM, TDN and CP is estimated at 7.46 MT, 14.87 MT and 1.96 MT, respectively.

5. As per FAO standards, total dry matter requirement in the state is estimated at 33.74 million tonnes against the availability of 27.87 MT, resulting a shortfall of 17.40 per cent of total requirement.

6. Actual feed consumption rates in the study area are different from the NATP standards or FAO standards. Actual rates are slightly lower for green fodders but significantly higher for dry fodder and concentrates. As per actual feeding practices, total annual requirement of feed and fodder in West Bengal during 2019 is 69.03 MT against the total availability of only 32.62 MT i.e., there is a deficit of 52.75 per cent.

7. Bulk of the feed requirement, as expected, came from cattle. Though the share of goat in total livestock population in the state is as high as 43.44 per cent, its share in the total requirement of feed and fodder is only 4.22 per cent of dry fodder, 12.52 per cent of concentrate, and 20.78 per cent of green fodder in West Bengal.

V.2: Policy Recommendations from the Study

The finding of the study shows that there are three distinct constraints to the development of livestock sector in West Bengal. One, predominance of indigenous breeds with low productivity; second serious constraints is acute shortages of feed and fodder; and third important constraint is limited reach/coverage of livestock extension services in the state. However, livestock rearing is a highly labour intensive and profitable enterprise in West Bengal and mostly run by the family members. Therefore, based on the findings of the study, the following policy interventions are suggested for sustainable development of livestock sector in West Bengal:

1. **Increase feed and prodder production in West Bengal:** The availability and efficient use of feed resources are the primary drivers to maximize the livestock production and productivity The findings of the study have amply demonstrated that there existed an overall shortage of all types of feed resources and the existing resources are not sufficient to meet the requirements of growing livestock population in the state. The reasons for huge feed-fodder deficiency in the state are lower acreage under fodder crops, limited availability of pasture and grazing land, acute shortage in fodder seed, and lack of awareness about fodder cultivation among the livestock farmers. Therefore, in order to increase feed and fodder availability in the state following interventions are suggested.

    - **Arrange training programme to popularize fodder cultivation:** As farmers are eager to take up fodder cultivation and interested in learning post harvest management techniques of fodder crops, there is a need to arrange training on

the same and to sensitize the farmers about benefits of fodder cultivation and its post harvest management.

- **Ensure timely availability of quality fodder seed**: Good quality fodder seeds need to be be supplied by concerned department at a subsidized price to promote fodder cultivation.

- **Promote maize and other fodder crops**: The agro-climate of West Bengal is suitable for maize. Maize is becoming popular in some pockets of West Bengal. Farmers, especially in North Bengal, may be encouraged to grow maize in more land to meet the demand. Similarly, average return from maize, sudan grass and gama grass are almost equal to amon paddy in South Bengal. But higher preference towards cultivating food crops is mainly due to age-old practice and perceived food security threat.

2. **Breed Improvement:** Although, the state of West Bengal has fourth largest number of livestock in the country, as high as 82.46 per cent of them are indigenous breeds with low productivity. Therefore, breed improvement is must to boost up the animal productivity. And for that the following interventions are needed.

    - **Increase coverage under crossbred cattle**: The coverage under crossbred cattle need to be increased through the production of superior quality bulls.

    - **Artificial insemination:** Upgrading indigenous cattle require production of superior quality semen and extensive coverage under artificial insemination programme in a mission mode in the State.

    - **Selective breeding:** Upgrading goat through selective breeding with high yielding purebred should be given priority.

    - **Buck/ram/bull replacement:** A mission mode programme on production of superior quality bucks/ rams/bulls and their distribution in a community as well as exchange/ withdrawal of old bucks/ rams/bulls needs to be undertaken for the promotion of profitable goat/ sheep/cattle farming among the smallholder farmers.

3. **Livestock Extension Services:** Inadequate coverage of livestock extension services in West Bengal remains a major area of concern. There is a felt need of various extension services in the state.

    - **Training on fodder cultivation and post harvest management**: There is serious lack of awareness about fodder cultivation and post harvest management practices among the livestock farmers. Training on modern techniques and technologies of fodder production and post-harvest management practices can incentivize the farmers to adopt fodder cultivation.

    - **Promote balanced feeding:** The nutritional status of the livestock and their productivity mostly depends on the amount and type of feed fed. Feeding balanced ration along with mineral mixture can increase both milk production as well as body weight of animals. However, the existing feeding practices in the state are deficient in available energy, protein and minerals. Throughout the state bovines are fed with rice husk (Bhusi/Kuro) which is neither recommended nor have any nutritive value. Therefore, awareness is needed to promote balanced feeding.

    - **Commercial livestock farming:** Awareness programme need to be organised to motivate the farmer for adopting livestock rearing as a commercial venture. Technical and financial support, including subsidies has to be extended to dairy farmers to transform traditional animal husbandry enterprises into commercial activity for production and marketing of milk.

4. **Others:** The animal husbandry and livestock sectors are critical for the rural economy, especially the land less labourers, women, and small and marginal farmers. Therefore, there is a need to ensure the followings.

    - **Promote backyard poultry and Black Bengal goat**: Besides fish and rosgolla, West Bengal has an insatiable appetite for goat meat, chicken and eggs. Desi chicken and Black Bengal goat is known for their taste in meat quality with a huge demand in West Bengal. Besides quality of meat, they can survive with little additional feed and are highly resistant to diseases and extreme weathers. Therefore, both backyard poultry and Black Bengal goat represents a golden opportunity for off-farm livelihood diversification.

- **Conserve Black Bengal breed**: West Bengal is blessed with the world famous meat type, prolific Black Bengal breed of goat. The conservation of these high valued animal genetic resources adopting a definite breeding policy is urgently required.

- **Promote FPOs in Livestock:** Since majority of the cattle rearing households are poor with very small scale production and local rural markets for livestock products are thin, and it is difficult for them to sale their produces at distant urban markets due to high transportation cost. Therefore, formation of FPOs need to be promoted for procurement of inputs like feed, fodder, vaccination, etc. as well as marketing of animal products.

- **Provision for animal shed**: Animal shed is essential for alleviating heat stress in livestock. Therefore, it is necessary to provide low cost, improved animal shelter with proper dimensions, sufficient light and ventilation for protecting the valuable animals from rain, sunlight, heat wave and cold and keeping the animals stress free.

- **Promote processing facilities:** Increased income, rapid urbanization and change in the food habits of the middle & upper strata of the society are increasing the demand for processed dairy and livestock products in the state. However, the processing infrastructure is very poor. Though there are few milk co-operatives operating in the state nonetheless these co-operatives function mostly as a collection centre for liquid milk only. They do not have required infrastructure and technology for milk processing and producing value added items like ghee, paneer, etc. There is severe shortage of large scale milk processing plants in the state. Considering the demand, processing of dairy, poultry and other animal products have the seminal potential to open up new vistas for large scale employment generation in the State.

- **National Livestock Policy:** Livestock sector continues to be a subsidiary activity to crop farming. Agriculture in India has come a long way through green revolution but livestock sector could not grow beyond artificial insemination and veterinary services. Therefore, there is a need for a separate National Livestock Policy with greater emphasis on feed and fodder.

V.3: Conclusion

Livestock rearing is one of the most important economic activities in West Bengal but scarcity of feed and fodder is a serious constraint for the development of this sector in the state. Predominance of indigenous breeds with low productivity; and poor reach of livestock extension services adds to the problem. Over the years, the share of crossbred livestock population is increasing, but the state is not able to raise feed and fodder availability due to the heavy pressure of growing staple and commercial crops. Sustainability of livestock farming depends on animal productivity. And the availability and efficient use of feed resources are the primary drivers to maximize the livestock production and productivity. Therefore, augmentation of feed and fodder production is the most challenging constraint that needs to be addressed immediately.

Till date there was no reliable estimate for feed and fodder at state level. The FAO standards of feed requirements are based on animal body weight but available only for dry matter. The NATP standards are average for whole of the country and are available only for four different categories of cattle and buffaloes. However, actual feeding practices differ across the regions as well as livestock species, breed types, stages of life, feeding practices, age and sex of the animal. The present study estimated feed and fodder availability and requirement based on FAO standards, NATP standards as well as actual feeding practices followed by the livestock rearing farmers in West Bengal.

In this study, green fodder availability is estimated from the latest (2018-19) land use classification data and dry fodder and concentrates availability is estimated from the latest (2018-19) available crop production data. Feed requirements are estimated from latest livestock census data (2019), where livestock population is broken down by species and age categories. Suitable and nationally accepted conversion factors/feeding rates are used to estimate the feed requirements. Regardless of the methodology or feeding rates applied, an inconceivable gap exists between the demand and supply of green fodder in West Bengal. The region is self-sufficient in terms of dry fodders, though majority of dry fodders are nutritionally poor paddy straws. Hence, suitable strategies should be developed for the efficient utilization of existing feed and fodder resources to improve animal productivity in this state. Since there was hardly any reliable estimate at state level, these state level estimates will provide a sound basis for determining the input output relations for the livestock sector in West Bengal and in effective planning and policymaking for this sector.

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ANNEXTURE-I

Coordinator's Comments on the Draft Report and Action Taken

1. **Title of the draft report examined:** Assessment of Livestock Feed and Fodder in the state of West Bengal
2. **Date of receipt of the Draft report:** 28 August 2020
3. **Date of dispatch of the comments:** 07 Oct 2020
4. **Comments on the Objectives of the study**:

   A part of the first, second and third objectives of the study have not been addressed. The first objective is to estimate the growth rates for area, production, productivity of major green and dry fodder crops, and to provide the land use classification data for the State whereas the second objective is to address district-wise and composition-wise livestock population and livestock products (Milk, Meat and Wool) of the state using 19 & 20th Census which needs to be compared with All India. In relation to third objective, we need to estimate the requirement of feed and fodders based on NATP, Sample survey and FAO.

   [**Action:** All the suggestions incorporated. State-wise growth rates in livestock population and livestock products (Milk, Meat, Egg and Wool) estimated using 19th & 20th Livestock Census data and compared with All India. Requirement of feed and fodder is estimated based on NATP, Sample survey and FAO. However, authentic data on fodder cultivation is not available for West Bengal. There are conflicting statistics so far as area under fodder crop in the state is concerned. Further, the available fodder area data is available only for few selected years and for few selected districts only not for the state as a whole. Thus, make necessary correction based on available data only.]

5. **Comments on the methodology:**

   Common methodology is followed for the collection of field data and tabulation of results has been followed. The estimation part of feed and fodder has been clearly mentioned in the methodology but not executed, which needs to be addressed. The availability (supply) of dry fodders and concentrates has to be estimated considering production data instead of total area.

   [**Action:** All the suggestions incorporated and the entire methodology is executed in this revised version. Estimation of availability (supply) of dry fodders and concentrates has been revised using production data as suggested.]

6. **Comments on analysis, organization, presentation etc.**

i) In chapter III, Table 3.1 should have both the total and average area, under the categories of irrigated, rainfed and total area with respect to landholding details of sample households.

[**Action:** Revised the table as suggested.]

ii) In chapter III, Table 3.2 should provide the area under different crops (cropping pattern) in rainfed and irrigated along with total. In addition, we should give per household data as well.

[**Action:** Revised the table as suggested.]

iii) In the Chapter III, regarding the estimation part of feed and fodder, it has been clearly mentioned in the methodology but, not executed properly in the case of Table 3.12. Similarly, the availability (supply) of dry fodder and concentrates has to be estimated by considering production data, instead of total area.

[**Action:** All the suggestions incorporated and the entire methodology is executed in this revised version. According all the relevant tables are revised and added few new tables for estimation as per FAO standards as well as for DM, TDN and CP.]

iv) Subsequently, Table 3.13 has to be re-estimated considering the availability of dry fodder and concentrates in the state.

[**Action:** Re-estimated all the relevant tables accordingly.]

v) As regard to returns from livestock, Table 3.19 should provide average milk yield per day and milk price per liter for different categories of animals along with average yield per annum.

[**Action:** Incorporated the suggestion and revised all the relevant tables accordingly.]

7. Overall view on acceptability of report

Authors are requested to incorporate all the comments and submit the final report for consolidation.

[**Action:** Incorporated all the comments suggested by the Coordinator. In addition to the specific comments, we have also incorporated all the generic suggestions sent to all the participating centres for updating the report, particularly on category-wise household socio-economic characteristics; land-holding details; estimation of DM, TDN, and CP; economics of livestock rearing; etc.]

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