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Agro-Economic Research Centre
(For the States of West Bengal, Sikkim and Andaman & Nicobar Islands)
Visva-Bharati, Santiniketan
West Bengal

Cost of Milk Production and Returns to the Milk Producers in West Bengal

Sridev Adak
Saptarsi Chakraborty
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Study sponsored by Ministry of Agriculture and Farmers Welfare
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Preface

The present study, entitled "Cost of Milk Production and Returns to the Milk Producers," forms part of an All-India Coordinated Study undertaken at the instance of the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. The responsibility for coordinating the study was entrusted to the Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Gujarat. The present report pertains to the state of West Bengal.

Dairying has emerged as an important auxiliary source of income for millions of rural households in India. It plays a crucial role in generating employment and supplementing farm income, particularly for marginal and landless farmers. Evidence from the present study also suggests that a substantial proportion of milk production in rural areas is contributed by households belonging to these categories. Thus, dairy farming continues to serve as an important livelihood support mechanism for rural communities and contributes significantly to nutritional security as well as rural income generation.

India currently ranks first in global milk production, although significant regional variations persist in terms of milk output and per capita availability. The country's milk production has increased remarkably from about 17 million tonnes in 1950–51 to more than 230 million tonnes in 2022–23, accounting for nearly one-fourth of the world's total milk production. The impressive growth of the dairy sector in India is widely attributed to the success of Operation Flood, popularly known as the White Revolution, which remains one of the largest integrated dairy development programmes in the world. The programme played a transformative role in strengthening cooperative institutions, improving procurement and marketing infrastructure, and enhancing farmers' participation in organized dairy markets.

According to data from the National Dairy Development Board, Uttar Pradesh is the largest milk-producing state in India, contributing about 15–16 per cent of the country's total milk production, followed by Rajasthan and Madhya Pradesh. A substantial share of national milk production originates from a group of major dairy-producing states, including Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, Maharashtra, Punjab, Bihar, Haryana, Karnataka, Tamil Nadu, West Bengal, and Telangana. These states together account for the overwhelming majority of the country's milk production. While many of these states benefit from stronger resource endowments and better infrastructure for dairy development, several eastern states still lag behind in terms of productivity and institutional support. Although milk production has grown substantially over time, productivity improvements have remained relatively modest. One of the key reasons for this is that dairying in many regions continues to be practised largely as a supplementary activity rather than as a fully commercial enterprise.

In this context, the present study was conducted across thirteen states, comprising the twelve leading milk-producing states with the highest levels of milk production and bovine (cow and buffalo) population, along with Assam representing the North-Eastern region of the country. These selected states together account for nearly 90 per cent of the country's total milk production and about 85 per cent of the total female bovine population, thereby providing a representative picture of the dairy sector in India.

This research study is the result of the collective efforts of several members of the research team, including Dr. Sridev Adak, Mr. Saptarsi Chakraborty, Mr. Mehedi Hasan, Mr. Rishav Mukherjee, and Dr. Sreejit Roy. The initiative taken by Dr. Sridev Adak in preparing this report is highly commendable. The contributions of the former Directors, Prof. Bidhan Chandra Roy (2018–2022) and Prof. Debasis Bhattacharya (2022–25), are gratefully acknowledged. The efficient assistance and services provided by the centre's administrative and support staff greatly facilitated the successful completion of this research. The efforts of Dr. Achiransu Acharyya, Deputy Director, in reviewing this research report merit special appreciation.

We would also like to acknowledge with gratitude the cooperation and support extended by Prof. S. S. Kalamkar, Director, and Dr. Hemant Sharma, Assistant Professor, Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar, Gujarat, for their effective coordination during the course of the study.

Our sincere gratitude is extended to Dr. Probir Kumar Ghosh, Hon'ble Vice Chancellor, Visva-Bharati, for his keen interest and insightful advice. We also acknowledge with appreciation the support and valuable guidance provided by the Adviser (AER Division), Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, in the completion of this study. The assistance extended by other officials of the Ministry is also gratefully acknowledged.

Finally, we would like to convey our sincere gratitude to the hundreds of villagers and milk producers who generously shared their valuable time and information during the field survey. Their cooperation and candid responses made the completion of this study possible.

Prof. Souvik Ghosh
Director (Honorary)

Date: 10th March 2026
Place: Agro-Economic Research Centre, Visva-Bharati, Santiniketan

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List of Abbreviations

AAY	Antyodaya Anna Yojana
ACP	Annual Credit Plan
AEZ	Agri Export Zone
AFC	Agricultural Finance Corporation
AGMARKNET	Agricultural Marketing Information Network
APL	Above Poverty Level
APMC	Agriculture Produce Marketing Committee
ATMA	Agriculture Technology Management Agency
BEA	Break-Even Analysis
BEP	Break-Even Point
BES	Break-Even Sale
BPL	Below Poverty Level
CACP	Commission for Agriculture Costs and Prices
CB	Cross-Bred Cattle
CI	Cropping Intensity
DAC&FW	Department of Agriculture, Cooperation & Farmers' Welfare
DAHDF	Department of Animal Husbandry, Dairying & Fisheries
DARE	Department of Agricultural Research & Education
DBT	Direct Benefit Transfer
DIPP	Department of Industrial Policy & Promotion
DoFPD	Department of Food & Public Distribution
DoLR	Department of Land Resources
DoPR	Department of Panchayati Raj
DoR	Department of Revenue
DoRD	Department of Rural Development
e-NAM	Electronic National Agriculture Market
ERFS	Extended Range Forecast System
FSSAI	Food Safety and Standards Authority of India
GAP	Good Agricultural Practices
GCA	Gross Cropped Area
IAY	Indira Aawas Yojna

ICAR	Indian Council of Agricultural Research
IDWG	Inter-Departmental Working Group
KCC	Kisan Credit Card
KMS	Kharif Marketing Season
KVK	Krishi Vigyan Kendra
LC	Local Cattle
LPG	Liquid Petroleum Gas
MANAGE	National Institute for Agricultural Extension Management
MCLR	Marginal Cost of Funds-based Lending Rate
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoF	Ministry of Finance
MoS	Margin of Safety
MoWR	Ministry of Water Resources
MSDA	Mission on Sustainable Dryland Agriculture
MSDE	Ministry of Skill Development & Entrepreneurship
MSME	Ministry of Micro, Small and Medium Enterprises
MSP	Minimum Support Price
NABARD	National Bank for Agriculture and Rural Development
NADP	National Agriculture Development Programme
NAFED	National Agricultural Cooperative Marketing Federation
NAM	National Agriculture Market
NFSM	National Food Security Mission
NITI Aayog	National Institution for Transforming India
PDCS	Primary Dairy Cooperative Society (Village Level)
PDMC	Per Drop More Crop
PDPS	Price Deficiency Payment Scheme
PGS	Participatory Guarantee System
PKVY	Paramparagat Krishi Vikas Yojana
PM KISAN	PM- Kisan Samman Nidhi Scheme
PM-AASHA	Pradhan Mantri Annadata Aay Sanrakshan Abhiyan
PMAY	Pradhan Mantri Awas Yojana
PMFBY	Pradhan Mantri Fasal Bhima Yojana
PM-KISAN	Pradhan Mantri Kisan Samman Nidhi

PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PMKVY	Pradhan Mantri Kaushal Vikas Yojana
PMS	Primary Milk Societies
SHG	Self Help Group
TC	Total Cost
TFC	Total Fixed Cost
TVC	Total Variable Cost

Executive Summary

1. Introduction

The process of development in dairy activities in India has been widely praised as one of the most successful development programmes in the world, namely 'Operation Flood', often called 'White Revolution'. India is ranked first in the world in milk production, followed by the European Union and the United States. The milk production in India has increased from 17 million tonnes in 1950-51 to 209.96 million tonnes in 2020-21, and it contributes 23 percent of global milk production. The Central and State governments have initiated several measures to increase livestock productivity, thereby significantly boosting milk production. Dairy activity can be considered an important auxiliary source of income for millions of rural families and plays a key role in providing employment and income, particularly for marginal farmers, as most milk-producing households are marginal and landless by their landholding categories.

There are large inter-regional and inter-state variations in milk production and in per capita milk availability in India. As per the data provided by the National Dairy Development Board, the largest producer of milk is Uttar Pradesh, which produces 16.06 percent of the total milk production in the country, followed by Rajasthan and Madhya Pradesh. In 2019-20, more than 90 percent of national milk production comes mostly from thirteen major milk-producing states, i.e., Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, Punjab, Maharashtra, Haryana, Bihar, Karnataka, Tamil Nadu, West Bengal and Telangana.

The impact of the 'White Revolution' can be seen in villages through the generation of funds for community development and social welfare, the creation of self-employment opportunities, the promotion of distributive justice, and the removal of the evil of untouchability. This silent social revolution has been relatively smooth and, as a result, even unnoticed by the conservative community. The fact that dairying could play a more productive role in promoting rural welfare and reducing poverty is increasingly recognized. But in West Bengal, it is partly true that, even though there is overproduction, the price of raw milk remains constant. In most cases, it fails to serve as a remunerative livelihood source. It is also interesting to note that West Bengal has recorded a total milch population of 7466, i.e., 5.47% of the total, but contributes only 2.96% to the National milk production, suggesting lower productivity of milch animals in West Bengal.

2. Main Findings

i. In the sample used for the study, it is found that only one household out of all sample units is of large type, i.e., having more than four milch cows. It reveals that if we consider our sample as a representative one for West Bengal, above 95 percent of the sample dairy farmers are of the small holding category, showing either reluctance about cow rearing or do not consider this culture in a commercial manner. It is also observed that most sample households are headed by a male member, which is not uncommon in rural Bengal. It is also observed that in the case of religion, Hinduism dominates significantly over all other religions, implying that Hindus, by nature, a religious community, are rearing cows as Çow-Seva, and also for domestic milk use.

ii. It is observed that both the total number of animals and the total milch animals are higher for local cattle than for crossbreed. It is found that 71 households have their own funded pucca cattle shed. It is found that the present value of any type of cattle shed is higher than the present value of fodder storage, and the average productive life is lower for a cattle shed than for fodder storage.

iii. Holding of most of the milking assets like milking cans, grass cutter and chopper, Feed container is increasing across milk producing categories, which is very usual. Earnings from a job or any service contribute more than any other income source. Income from agriculture and from the sale of milk, cow dung, and urine is increasing across milk-producing groups. Dairy income pushes total annual income to increase. The average milk yield is highest during the rainy season, followed by summer and winter. It is very obvious that in rainy weather, cows eat more as this is the harvesting time. The milk yield of both breeds is increasing across milk-producing categories. It is noticed that the average milk rate is lower for the local cow.

iv. Cattle are the only major dairy animals, and buffalo are quite negligible in our sample, at least in the state of West Bengal. Local cattle (LC) have a lower estimated present market value than cross-bred cattle (CB) among small and medium-sized farmers. The average age and average age at first calving are higher for the local cattle (LC) than the cross-breed cattle (CB) across the farming category. The average lactation order is similar for both LC and CB cattle, at around 2.5.

v. The average dry and in milk period for LC milk is much higher than that for CB milk in our study area. The overall dry and milk periods for LC milk are approximately 245 and 263 days, respectively, whereas they are approximately 179 and 309 days for CB. The average milk drawn (two times a day) in milking time is severely lower for the LC cattle (1.54 lit/day) than the CB cattle (4.34), and the average milk drawn (lit/day) of the CB cattle is about 181.82% higher than the LC cattle.

vi. There is no significant difference in feed and fodder quantity consumption between the in milk and dry periods for green fodder and dry fodder across the size of milk producers, but it varies as per the change in season. The consumption of green fodder is significantly higher in the rainy season than it is in the winter. This is due to the free availability of green fodder, such as grass, during the rainy seasons. The increase in consumption of green fodder leads to a decrease in the consumption of dry fodder in rainy seasons compared to winter seasons.

vii. The study discovered a significant change in average price of dry fodder across the size of milk producers and seasons. The respondents of the sample area have reported that there is no cost incurred for the grazing. It is found that the average cost of labour is about Rs. 66 per day per milk animal, and almost 99.7% of the total labour cost is contributed by family labour. The average veterinary cost is Rs. 2.27/- per day per milch animal, and the Artificial Insemination (AI) cost is Rs. 244 per year per cattle, respectively. The study has found no transportation cost and a tiny amount of light and water cost in the sample area of West Bengal.

viii. It is clear from the study that local cows are generally reared for domestic consumption of milk and cross breeds are mainly for commercial purpose. The study found that the overall cost per day for cross-breed milk is higher than for local milk, and the same

holds for small- and medium-sized milk producers. This indicates that as cattle size increases, the marginal cost per day per milch cow decreases for both local and cross-breed milch cows.

ix. From the study, it is found that earnings from cross-breed cattle are more than 2.5 times higher than the earnings from local milch cattle. The study has found a positive relationship between gross income and the size of milk producers across breeds of milch animals. The study found that the critically low net income from local cattle is due to low daily milk yield. Low market prices and high feed costs are also important factors contributing to low income from dairy activities in the state of West Bengal.

x. The study has adopted the sensitivity analysis with two conditions, a decrease in fodder cost by 5% & increase in milk yield by 5%. The analysis shows that the percentage change in net income is greatest when both approaches are used together. In comparing these two approaches, the study found that a 5 per cent increase in yield is more effective in increasing income than a 5 per cent reduction in fodder costs.

xi. It is found that overall earnings per litre for the lactation period are negative for the in-milk local milch animal, which is indicated by the high average variable cost over the sale price per litre of milk, not covering the part of operational expenses by producing milk. The overall BEP per cross-breed milch per lactation is 167.90 litres as observed in the sample study for West Bengal. Across the size of milk producers, it is found that small local milk producers are facing operational losses. But in case of paid out cost, the BEP for lactation period, it is found that all the BEP are feasible as no milk producers are facing loses considering the paid-out cost. The table also found that the overall BEP was lower for local cattle (52.28 litres), compared to cross breed cattle (53.83 litres) and across all the sizes of milk producers, the results are also the same.

xii. As per the lactation period, the MoS ratio (explained in percentage) is highest, i.e., the risk position is lowest for medium-sized milk producers. The percentage of MoS is not feasible for small local milk producers as the producers are running with losses considering the total cost of cultivation. But in paid out cost the percentage of MoS is also feasible for both local and cross breed cattle, and the risk factor associated with milk production is higher for milk producers with local cattle than for those with cross breed cattle. Again across the size of milk producers it is found that the risk position is high for small milk producers than the medium and large milk producers.

xiii. Overall percentage of BEP to total output per lactation can be calculated for cross-breed milch and for local it is infeasible as BEP is not calculated due to the average variable cost per litre being higher than the average selling price, i.e., the sector is already in a loss position. Across the size of milk producers, it is found that the percentage is lower for medium size of milk producers.

xiv. But as per paid out cost the overall percentage of BEP to total output is lower for cross breed cattle (3.2%) compared to local cattle (9.3%) milk producers. Across the size of milk producers the result is better for medium size of milk producers than the others.

xv. The study found that the overall BEP for the cycle of both the local milch cattle and cross-breed milch cattle cannot be estimated, as for the cycle, the average variable cost per litre of milk is much higher than the average selling price per litre of milk. This indicates that, in a cycle, both local and cross-breed milch cattle producers are at a loss. However, with the paid-out cost, the overall BEP for the cycle is feasible (119.43) for only cross-breed cattle, and for local milk producers, the BEP cannot be estimated. Across the size of milk producers, it is found that small local milk producers face losses and cannot cover the cost from the selling price of milk per litre, hence, the BEP cannot be calculated. Medium milk producers earn some profit above the cost of milk production.

xvi. In the comparison of analysis between total cost approach and paid out cost approach it is evident that the milk producers are not operating as a professional production units as here the farming activities are continuing with a severe loss situation but one professional milk producers will not proceed for the production after operational loses.

xvii. The milk producers in West Bengal are continuing the dairy activities as they cover the paid-out cost part of the lactation period, which is incurred for the dairying activities, but they have compromised the imputed cost. The waste and by-products from cultivation are used as the main fodder in the state of West Bengal. Most milk producers are also cultivators, so the importance of continuing milk production lies in using waste and by-products as cattle fodder without incurring significant actual paid-out costs.

xviii. From the constraint analysis, it is observed that most of the respondents agree that high feed cost is a problem in milk production. It is also evident in our results. The percentage is higher for small producers. Over 60 percent of households say that the timely non-availability of fodder, especially hay, is a constraint in milk production. The higher price of milch animals is not a problem for milk production, as they revealed that value determines a cow's quality.

xix. About half of the sample households reveal that low milk yield of milch animals is a problem which calls for breed improvement of milch animals. Over 70 percent of the sample households have responded that the milk price should be higher to generate more income from milk sales. It is also found that most of the sample households said that the high cost of veterinary medicines, which added to the cost of milk production, was a major concern, while the lack of nutritious food for animals was not a severe problem for milk production.

xx. Most of the households admitted that they have poor knowledge about feeding and healthcare, calling for an increase in consciousness and proper education in the village about feeding management and healthcare through block livestock development officers and local Pranimitras. Half of the total sample cited inadequate or insufficient finance to invest in the dairy business for quality milk production cannot be considered a primary problem.

xxi. Unavailability of green and dry fodder throughout the year was there, can be considered as a major problem in feeding management. It is also found from the responses that the majority of grazing land are degraded and encroached. It is

interesting to see that most households have never heard of PDCS. So, PDCS is needed to develop the dairy sector in West Bengal.

xxii. The high cost of cattle feed and mineral mixture cannot be considered to be a primary problem since half of the sample is neutral. This is probably happening because of the reduced use of cattle feed and mineral mixture. High cost and low returns cannot be considered major problems, as fodder production culture is not established. Regarding the diversion of feed and fodder ingredients for industrial use, most households are neutral for the same reason previously mentioned.

xxiii. From the responses, it is found that the lack of necessary space to tie the animals is not a big problem in feeding management. It is also observed that the farmers have land to cultivate fodder seeds, but due to the traditional cropping system, no one is attempting to cultivate fodder.

3. Policy Suggestions

India still stands first in milk production in the world, although there exist large inter-regional and inter-state variations in milk production as well as in per capita availability of milk in India. From the survey data, it is found that in West Bengal, dairy farming is carried out at a domestic subsistence level, but it needs a professional touch with the help of a commercial think tank. This study concludes with the following recommendations to guide the development of the dairy business in West Bengal.

a) Feed and fodder costs, the dominant component of the total cost structure, are increasing day by day under the prevailing market mechanism in the dairy business. This directly raises the cost of dairy inputs and reduces earnings from dairy activities. There is a need to control the upward trends in feed and fodder costs. The best strategy, as suggested by the study, is the development of feed and fodder cultivation through the initiative of the PDCS and other governmental or non-governmental organizations. In this study, it is observed that most farmers have land, and ensuring infrastructure for fodder cultivation would be an optimal policy for dairy development in West Bengal.

b) Another common issue identified in this study is the low milk yield in dairy animals. Increasing the yield rate of milch animals is another important issue to consider. Increasing milk yield is not easy, but some strategies can be used. The main problem with the low milk yield is the poor quality of the cattle breeds. The government should take the necessary steps to provide high-yielding breeds and genetic improvement for milch animals.

c) The study found that there is a lack of support from the local government authorities in providing scientific and technological knowledge to the milk producers. But the local authorities have a crucial role in providing adequate scientific and technological knowledge regarding high-yielding breeds, AI, feeding management, and healthcare to the milk producers at the village level. Hence, the study recommends enhancing the effectiveness of existing government authorities by providing them with adequate scientific knowledge to improve milk production at the village level. By increasing the number of milking days in a lactation cycle, proper feeding management, and access to healthcare facilities, the yield rate and milk production can be increased. The sample

households are also unaware of animal insurance. Therefore, knowledge of animal insurance should be provided through the government. officials.

d) The main hindrance to dairy activities found in the study is the inadequate earnings from milk production. In this regard, the study has identified another point: the critical minimum sale price of milk. The study argues that the lack of a smooth, horizontal milk market and poor supply chain management are the reasons for low milk prices. Most milk producers sell their output domestically to NDCS agents, middlemen, or consumers or hotels. For the milk producers in the hill regions, it is also hard to find such a marketing chain; as a result, instead of selling milk, the milk producers in that area prepare "butter" and some by-products like ‘Churpi’ and then sell those products in the local market, which is considered to be the main earning from milk production. An efficient marketing system, combined with effective milk supply chain management in the village, can solve the problem. So, the governing authorities, along with policy experts, should take the initiative to address the obstacles in West Bengal.

e) The cooperative milk unions also have a major role in marketing milk and supply chain management. There are currently 13 cooperative milk unions registered in West Bengal Cooperative Milk Producers Federation Ltd., which procures milk from milk producers of potential villages through the primary milk society. There is a need to increase the number of milk unions and primary milk societies at the village level, with greater operational efficiency across the various districts of the state. A special focus is needed on the state's northern region, especially the hilly region, as the milk union is currently not operating in the majority of the districts in that region.

f) Policy should encourage milk producers' companies to enter the dairy sector, specifically in milk marketing and supply chain management at the village level.

g) There are various types of support schemes initiated by the central government and NDDB jointly, but it was found in the study that most of the sample farmers are unaware of these schemes, so the benefits are not distributed evenly to the milk producers at the village level. NDDB has developed a number of app-based supporting technologies, such as "e-Gopala" and "Pashumitra," but the majority of people in our sample area are unaware of any of them. There is a need to promote the benefits of such schemes to milk producers, and their smooth implementation is needed immediately in the village.

h) In the state of West Bengal, most of the milk producers are rearing cattle only to use their agricultural by-products and wastes as fodder for cattle rather than as a profit-making business. Government subsidies for dairy development for all types of milk producers are falling short of their objectives to generate professionalism in milk production. Instead, it is necessary to set up a target group of potential milk producers and a special drive to provide them with the benefits of various developmental schemes, thereby creating a group of productive and potential milk producers for the development of the dairy sector.

i) Availability of credit for purchasing high-yielding animals is another possible way of strengthening the dairying sector in the state of West Bengal. Most of the milk producers in this study agree that the lack of finance for dairy activities is a major

constraint for dairy development. The availability of credit facilities with subsidised interest rates can also develop the concerned sector to an optimal level.

j) Other incentives like subsidized bio-gas unit may be given to the large milk producers which may increase their income from dairy in one hand and on the other hand that may give an encouragement to others for rearing a large number of milch animals, as a result numbers professional large milk producers will be increased in the dairy sectors in West Bengal.

Chapter I
Introduction

1.1 Introduction

"India's place in the sun would come from the partnership between the wisdom of its rural people and the skill of its professionals."

------- *Verghese Kurien*

The process of development in dairy activities in India has been widely acclaimed as one of the most successful development programmes in the world's most extensive integrated dairy development programme, namely 'Operation Flood', popularly known as 'White Revolution' in India (Shiyani, 1996; NAAS, 2003). India is ranked first in the world in milk production, followed by the European Union and the United States. The milk production in India has increased from 17 million tonnes in 1950-51 to 209.96 million tonnes in 2020-21 and it contributes 23 percent of global milk production. Nearly 51 percent of milk production is contributed by buffaloes, followed by cows (45%) and goats (4%) in 2020-21. As per Basic Animal Husbandry Statistics, the per capita availability of milk in the country has also increased significantly from 130 grams/day in 1950-51 to 427 grams/ day in 2020-21 which is much higher than the world average of 322 grams per day during 2020-21, that elicits a sustained growth of milk and its by-products availability for the growing population in India. The Central and State governments have initiated several measures to increase livestock productivity, thereby significantly boosting milk production.

As per the annual report of the Ministry of Fisheries, Animal Husbandry and Dairying, 2020-21, dairy activity can be considered as an important auxiliary source of income for millions of rural families and serving the most important role in providing employment and income-generating source particularly for marginal farmers as it is evident that most of the milk is producing households are marginal and landless by their land holding category. To further amplify the growth in the livestock sector, making it more remunerative for approximately 10 crores of farmers engaged in animal husbandry. Govt. also leveraging the amount of Rs 54,816 crores for the next 5 years as an investment in the animal husbandry sector Livestock Sector has gradually been growing at a Compound Annual Growth Rate (CAGR) of 7.93% at the constant price from 2014-15 to 2020-21, which is quite higher than the CAGR of the

manufacturing sector of 4.93% and Service Sector of 4.82% at constant price and in contrast to Agriculture (Crop Sector) CAGR of 2.05% at constant price. The agricultural sector contributed 8.96% to total Gross Value Added (GVA) at constant prices, whereas the livestock sector contributed 4.90% to total GVA in 2020-21[1].

India still ranked first in milk production worldwide, although there are large inter-regional and inter-state variations in both milk production and per capita availability. According to data from the National Dairy Development Board for 2020-21, the largest producer of milk is Uttar Pradesh, which accounts for 14.94% of the country's total milk production, followed by Rajasthan (14.63%) and Madhya Pradesh (8.57%). In 2020-21, more than 90 percent of national milk production comes mostly from thirteen major milk-producing states, i.e., Uttar Pradesh (14.94%), Rajasthan (14.63%), Madhya Pradesh (8.57%), Gujarat (7.55%), Andhra Pradesh (7.01%), Maharashtra (6.53%), Punjab (6.38%), Bihar (5.48%), Haryana (5.37%), Karnataka (5.21%), Tamil Nadu (4.66%), West Bengal (2.94%) and Telangana (2.75%). Only 10 States had per-capita availability above the national average of 427 gm. per day in 2020-21. Major milk-producing states in the country have strong resource endowments and infrastructure, while the eastern states are lagging behind in dairy development. The government has initiated various dairy development programmes. Although milk production has increased considerably over the years, productivity has not yet improved. One of the main reasons for such low productivity is that dairying is not practised commercially. Therefore, studies related to the economics of milk production have gained greater prominence in recent years.

Most of the milk is produced by animals reared by small, marginal, and landless farmers and labourers. It has been experienced over the years that the stability in dairy income is far stronger than the income realized from agricultural activities. The rural dairy co-operatives were set up to strengthen the social and economic life of rural India. In India, 80 million women were engaged in dairy farm activities and thus it could be considered to be a crucial source of livelihood for the poor in India[2]. The impact of the 'White Revolution' can be seen in the villages in the form of the generation of funds for community development and social welfare, creation of self-employment opportunities, ensuring distributive justice, and removal of the evil of untouchability. This silent social reform has been relatively smooth and hence even unnoticed by the conservative community. The fact that dairying could play a more

[1] http://dahd.nic.in
[2] https://www.rediff.com/business/interview/why-indias-milk-producers-are-angry/20180717.htm

productive role in promoting rural welfare and reducing poverty is increasingly recognized. It is generally believed that farmers who combine dairy farming with crop farming do not commit suicide because small dairy operations supplement their family income. However, during the last few years, production has been steadily increasing. Therefore, over-production of milk resulted in a price reduction and milk prices have been reduced by 20 percent, thereby reducing profit margins, while dairy farmers are suffering from low prices, consumers are paying a high price for milk. But in West Bengal, it is partly true: in some cases, even though there is overproduction, the price of raw milk remains constant. But in most cases, it fails to be a remunerative livelihood source in West Bengal.

India is also home to a significant share of the world's livestock population. India stands at the first position in terms of cattle & buffalo population in the world. As per the 20th livestock census, India's total bovine population in 2019 is 302.78 million, with an overall increase of 1 percent over the previous livestock census of 2012, while the total livestock population was 535.78 million. India has the world's largest livestock population, accounting for over 37.28% of cattle, 21.23% of buffalo, 26.40% of goats, and 12.17 % of sheep. Across Indian states, the highest bovine population was recorded in Uttar Pradesh, followed by Rajasthan, Madhya Pradesh, Bihar, Gujarat, Maharashtra, and West Bengal, and these states together accounted for one-half of the country's total bovine population. It is also interesting to see that West Bengal has recorded a total milch population of 7466, i.e., 5.47 % of the total, but contributes only 2.96% to the National milk production, which may suggest a lower productivity of milch animals in West Bengal.

1.2 Review of Literature and Need for the Study

Since independence, the shift from cultivators to agricultural labourers has been significant in West Bengal. From a policy perspective, it is essential to create employment in rural areas (Majumder et al., 2017). The livestock sector is considered to be an integral part of Indian agriculture. Among various agricultural enterprises, common households maintain livestock as a complementary activity to supplement family income and nutritional needs. Considering the monsoon's adverse effects on crop production, dairy farming is emerging as a major source of supplemental income, creating employment opportunities, and has broader socio-economic dimensions. But there is insufficient literature related to the economics of milk production. Dairy cooperatives have played a significant role in the production, marketing, and processing of milk and their products (Candler & Kumar, 1998), thereby contributing

towards livelihood security for millions of milk producers in the country. Milk production alone involves more than 70 million producers, each raising mostly one or two cows/buffaloes primarily for milk production (Meena et al, 2015). Generally, a milk producer can increase their dairy income in two ways, either by increasing milk production or by reducing the cost of milk production. An increasing price of raw milk also can play a pivotal role here.

In order to meet current and future demand of global milk availability it is important to provide efficient and judicious use of feed and fodder resources to the milch animal. Countries in Africa and South Asia, dairy activity is considered as a significant weapon to alleviate rural poverty (Duncan et al., 2013; Staal, 2001).

In Bangladesh, dairy farming is mainly dominated by smallholders, and they also take it as an important subsidiary source of income. The dairy farms are earning monthly on average 73% net return from the average monthly revenue of US$79 per cow. Naturally, cross breed cows are providing more financial benefits to the farmers Therefore, a suitable policy towards farm modernization and breed management is needed to eradicate rural poverty by dairy farming in Bangladesh (Datta et al., 2019). In Sirajganj district of Bangladesh it is seen that there is no cost difference between small and large farm. It is possibly explained by differing production systems, in particular the related feed cost. Small farms graze their animals in public land for free while large farms have to purchase feed and fodder from the market. Therefore, despite of having fewer animal and thus a lesser milk amount produced the cost differences compensates the net return (Hemme et al., 2004).

A study was carried out in the up country wet and intermediate zones in Sri Lanka, revealed that education has no effect on the income of farmers from dairying. It also elicited that mean herd size is higher for intensive dairy management systems compared to semi-intensive dairy management systems. It was also observed that post-weaning mortality was significantly lower in the intensive system than in the semi-intensive system, and milk yield per herd, income, labour, and other costs (concentrates, drugs, and services) per herd were higher in the intensive system, leading to non-significant profit differences. Net returns per herd per day were also much higher for the intensive system, excluding the labour cost. The study suggested that introducing good manure management practices and establishing high-quality pasture and fodder along the contour lines of the farm, as well as along the fence line, would help reduce labour costs for cutting grass and concentrate feeding expenses while increasing

profits. Animal upgrading can also lead to higher herd production in a semi-intensive system (Bandara et al., 2011). The development of the Dairy sector in Sri Lanka is constrained by several factors, such as low productivity, low profitability, low gate prices, and high production costs (Hitihamu et al., 2007). A study in Sri Lanka found that milking frequency is a significant factor in the average cost of milk production. This is happening because of a poor marketing channel and the long distance from the milk gate to the collection centre, which is adversely affecting milking frequency. The cost of milking twice a day is lower than once a day. So, it is important to provide proper infrastructure to develop a marketing channel, a storage facility, and a cooling system (Gunarathne et al., 2015).

A study in the Gambia identified hindering factors in domestic milk production, including a lack of interest from decision-makers, distorted economic policy, and biotechnical constraints. The study also revealed that the then milk production system is viable and obvious. Constraints in increasing productivity include a lack of improved technology at the farm level and weak institutional support in those areas. It is presented that a reliable amount of income has been generated from milk production, despite the low viability status, which could be a possible retreat for most small-holding farmers to intensify farming systems, especially in those areas where no loan schemes exist to purchase agricultural inputs in Gambia (Somda et al., 2005).

Efficient nutrient use is needed for cows with high genetic potential, but it can do little for those with low genetic potential. Advances in nutritional knowledge can influence increasing a cow's feed energy intake, refining nitrogen components in feed, and the need for nutrients such as phosphorus. Underfeeding of protein poses a higher risk than overfeeding, so the efficiency of protein use cannot be maximised in the past or near future. These advances made and will make dairy sector more productive and profitable (VandeHaar & St-Pierre, 2006). Using the U.S. Department of Agriculture's Agricultural Resource Management Survey data it was shown that for pasture-based milk production compared to conventional method of milk production, on an enterprise basis net return over the operating cost was higher, and over the total cost, it is lower per hundred weight milk produced (Gillespie & Nehring, 2014).

The culture of the Automatic Milking System (AMS) has already been introduced in Europe and in some areas of the USA. A study found that the highest farm net return to management and unpaid factors is realised when AMS is set to the maximum milking capacity, and that

this increases production by 5 percent. But under the current assumption of a single stall rather than multiple stalls, the economic return from AMS use is quite similar to the parlour system on smaller farms when the milking capacity of AMS is well matched to herd size and production level (Rotz et al., 2003).

In the case of Punjab, fodder management needs to be smoother as the estimated fodder availability is more than the estimated value of fodder requirement by the Adult Cattle Units. So, policies towards developing blocks of fodder in the state and proper transport is needed to fodder deficit areas in Punjab (Tanwar & Verma, 2017).

A study in the Alwar district of Rajasthan revealed that the per-litre cost of milk production is slightly lower for co-operative member milk producers, which can be attributed to higher milk yield per animal. Gross income, farm labour income, family labour income and net income per milch are higher for member milk producers and relatively higher income is observed compared to non-member producers (Meena et al., 2010).

Animal holding size also plays a crucial role here, as economies of scale are particularly evident in feed and fodder management. In the Ahmednagar district of Maharashtra, maintenance costs are higher and average productivity is slightly lower for large holders than for small holders. The net return from per litre milk was also high, i.e., Rs 2.16, hence all sample producers were financially viable, earning a moderate profit over the year (Ghule et al., 2012).

Price is also an important factor; we talk about net returns going to the milk producers. Two-axis pricing policy is followed in the dairy business in Tamil Nadu, which is also among the major milk-producing states in India. The cost of milk production is essential to understand the efficiency of milk production and price fixation. Private dairy farmers earn higher profits because their milch animals receive better care, which in turn increases their productivity. The cost of milk production per litre is higher for large farmers (Umamageswari et al., 2017). In determining price models for this purpose, it is effective to take into account non-price factors, such as technology, alongside price factors. In this very model, it is estimated that to maintain the constant return to the cost of production of milk, an upward price adjustment of 9.97 percent is required, and to maintain constant net monetary income, this upward adjustment is 10.30 per cent for buffalo milk in Tamil Nadu, taking 2003-04.as the base year in 2009-10 (Saravanakumar & Jain, 2009). The development of dairy co-operatives in some

states, such as Gujarat, Maharashtra, and Tamil Nadu, improved their economic conditions and well-being (Benni, 2005).

In Mandya district of Karnataka, the productivity of milch animals was lowest for local cows, followed by buffaloes and cross-breed cows; similarly, the feed and fodder consumed by them were lowest for local cows, followed by buffaloes and cross-breed cows. Usually, per day maintenance cost is found to be highest for cross-breed, followed by buffaloes and local cows, respectively. Among all the maintenance cost feed and fodder cost was highest, followed by labour cost and net return was also highest for cross breed, followed by buffaloes and local cows (Sunil et al., 2016).

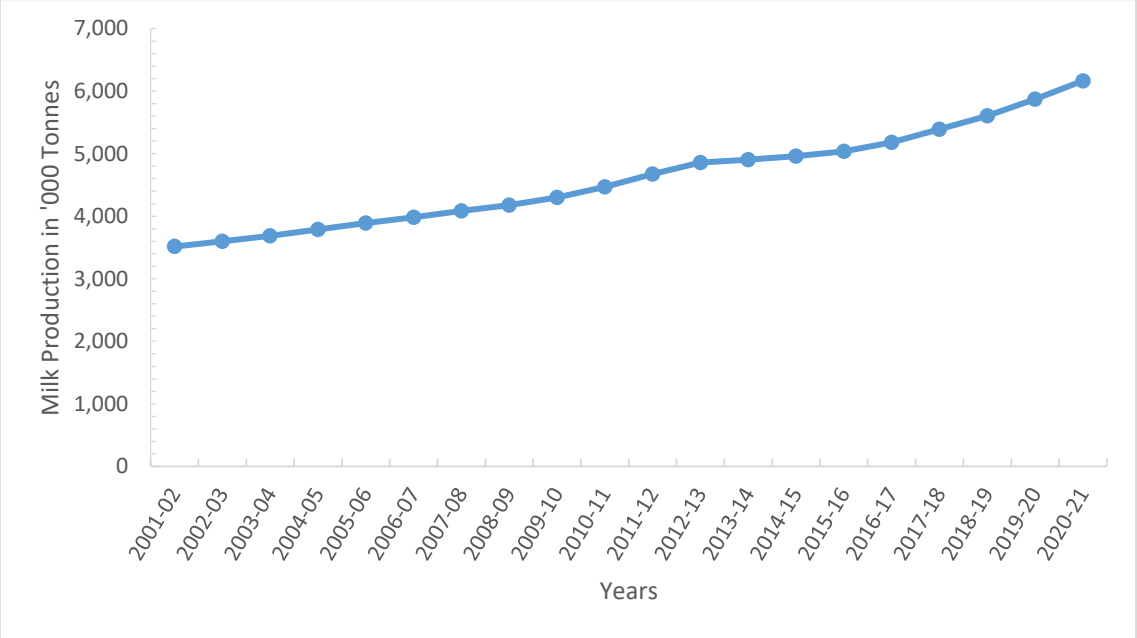
A study in the Muzaffarnagar district of western Uttar Pradesh has concluded that imbalanced feeding is predominant in the experimental area, and after giving intervention to the pre-balanced group, balanced feeding significantly increases the immunity, productivity, and also the profitability of the dairy enterprise. The study suggested supply of proper and balanced feeding system and ration reappropriation technique in field condition is needed as a policy prescription (Asgar Ud Deen et al., 2019).

Jharkhand Government recently launched various dairy development programmes by adopting new technologies. When technology shifted from local cow to cross-breed cow, a change in total yield is observed, 80.59 per cent, out of which 73 percent is contributed by the change in technology, and the remaining 8 per cent is the change in input use level. It indicates that cross-breed cows are more potent in the yield rate of milk, but a considerable effort is needed in the input use level (Horo & Chandel, 2018).

From a primary survey in Punjab, Haryana showing dynamic dairy production and in West Bengal, Odisha states where dairy development is going through transient phase, analysis of the midstream value chain of compound cattle feed found that the cattle feed manufacturing units realized 18%-22% profit margin before tax, whereas upstream value chain suffers from higher volatility in prices of feed ingredients, Unskilled labour force, irregular power supply, lack of quality testing facility and lack of finance from banks. The study suggested possible intervention in four major areas of the cattle feed industry, like quality assurance and feed safety, capacity and skill building, maintaining profitability and value chain financing (Sirohi et al., 2017).

West Bengal has both the raw milk availability and demand for milk and its products. The milk-based sweet industry has a raw milk demand of over Rs 2000 crore. It is important both for meeting domestic demand and for export purposes. As per the National Dairy Development Board (NDDB) report, milk production in West Bengal rose to 6165 thousand tonnes in 2020-21 from 3515 thousand tonnes in 2001-02, as shown in Figure 1.1. So, in West Bengal it is important to strengthen its co-operative model like Gujarat. Both intrinsic (genetic potential) and extrinsic factors (nutrition management, farm management, veterinary aids and breed improvement schemes) should be undertaken to amplify the growth of milk production (Sarkar & Dutta, 2020).

Figure-1.1: Trends in Milk Production in West Bengal



Source: Statistics from the National Dairy Development Board

A study comparing co-operative and non-co-operative milk farming in West Bengal found that variable costs accounted for a major portion of total costs, and feed costs accounted for the largest share of total variable costs in both systems. In total, fixed cost interest on capital has the major contribution. Considering the differences in the average cost of milk production, i.e., Rs per day per milch cow, between co-operative and non-co-operative farms, is not so far from uniformity. It is also observed that the average net benefit and benefit-cost ratio are considerably high and significant for all good co-operatives compared to either all bad co-operatives or good or bad non-co-operatives. The regression results also indicated

that, across all farm types, feed cost and dry food are positively and significantly associated with average milk yield per milch cow.
It is also found that profitability is much higher for co-operative farms and non-BPL farms that work under both co-operative and non-co-operative structures are more beneficial than any BPL farms (Sarker & Ghosh, 2008).

A report on an assessment of the status of dairying and the potential to improve the socio-economic status of milk producers in West Bengal shows that the number of co-operative societies under the jurisdiction of milk unions was highest in Bankura, while it was lowest in South 24 Parganas. The villages associated with dairy co-operative societies have greater herd strength in terms of local milch animals than non-member villages across all size classes. It is completely opposite in the case of rearing cross-breed cows. It is also observed that labour costs are the main component of total costs in all cases. It is obvious in terms of the imputation of the ruling wage rate. In non-member villages, most of the milk is sold to the private vendors and middlemen (Majumder et al., 2017).

In a study on the assessment of feed and fodder in West Bengal, it was found that Livestock rearing, despite being one of the most important economic activities, faces a prevalent constraint: scarcity of feed and fodder. The share of cross-breed cows is increasing in the state, but the state is unable to increase feed and fodder availability due to pressure from growing staple and commercial crops. Increasing animal productivity is the main challenge in West Bengal and needs to be addressed immediately. So, breed improvement and feed fodder availability are hours of need (Roy et al., 2020).

However, the literature above makes clear that cost plays an important role in determining the economic viability of a dairy enterprise. It is a critical economic indicator for milk producers, consumers, and policymakers, providing an effective link between producers and consumers to rationally fix milk prices. The cost of milk production often becomes a policy issue when milk producers grumble that the price they receive does not cover those costs. One of the main problems identified is the lack of awareness among dairy producers, especially small operators, of their production costs and financial breakeven point.

It is important for producers to identify ways to reduce costs without reducing milk production. The Break-even point is often used to estimate the minimum quantity of milk to be produced to cover the total cost of milk production. A comparison across all household

sizes for both cows and buffalo can be useful for various decision-making. With these considerations, knowledge of the cost of milk production is an important tool for evaluating the economics of dairy enterprises at the producer level, ensuring that producers receive remunerative prices for milk and that consumers obtain milk and milk products at reasonable prices. The objective of the present study is to analyze the costs and returns to milk production across different herd sizes.

1.3 Objectives of the Study

Following the above lines of literature to fulfil the research gaps the specific objectives of this study are as follows:

i. *To study the socio-economic characteristics of dairy owners in the study area.*
ii. *To estimate the cost of milk production per animal across breeds in different categories of dairy farms in the study area.*
iii. *To estimate the break-even point to determine the level of milk production needed to recover all the costs in the study area.*
iv. *To undertake the sensitivity analysis covering different scenarios to suggest suitable interventions.*

The details of the sampling and analytical framework for achieving the objectives above are presented further.

1.4 Data and Methodology

1.4.1 Data Sources

The study is based on both secondary and primary level statistics.

- The secondary data compiled from the published sources and websites of DAHD, GOI; NDDB, Anand; state Department of AH & D.

- For the study, primary data have been collected from the selected Milk producers through well-designed, structured and pre-tested schedules.

1.4.2 Study Area

The study is conducted in 11 major states[3] having the highest milk production and the highest total bovine (cow & buffalo) population, and Assam state among the North-Eastern States of India. The selected states account for 89 percent of total milk production and 85 percent of the total female bovine population in the country (Table 1.1).

The field survey was carried out by the respective AER Centre, and an authenticated Excel data sheet was provided to the study's Coordinator within the stipulated timeline. The selected states for the study are:

- *Uttar Pradesh (AERC, University of Allahabad, Allahabad, UP)*
- *Rajasthan (AERC, Sardar Patel University, Vallabh Vidyanagar, Gujarat)*
- *Madhya Pradesh (AERC, J.N. Krishi Vishwa Vidyalaya, Jabalpur, MP)*
- *Andhra Pradesh (AERC, Andhra University, Waltair, AP)*
- *Gujarat (AERC, Sardar Patel University, Vallabh Vidyanagar, Gujarat)*
- *Punjab (AERC, Panjab Agricultural University, Ludhiana, Punjab)*
- *Maharashtra (AERC, Gokhale Institute of Politics & Economics, Pune, MS)*
- *Haryana (AERC, Delhi University, Delhi)*
- *Bihar (AERC, TM Bhagalpur University, Bhagalpur, Bihar)*
- *Tamil Nadu (AERC, University of Madras, Chennai, Tamil Nadu)*
- *Karnataka (ADRTC, ISEC, Bangalore, Karnataka)*
- *West Bengal (AERC, Visva-Bharati, Santiniketan, WB)*
- *Assam (AERC, Assam Agricultural University, Jorhat, Assam)*

[3] The composite index was estimated by equal weightage to state share in milk production and female bovine population at national level.

Table 1.1: State-wise Female Bovine Population and Milk Production in India

Sr. No.	State / UTs	State/UT-wise population of Adult Female Bovine 2019		State-wise estimates of Milk Production (2018-19)	
		Total Cows & Buffaloes ('000 Nos.)	% to the Total for India	('000 tonnes)	% to Total for India
1	A & N Islands	17	0.01	18	0.0
2	Andhra Pradesh	5,141	3.77	15,044	8.0
3	Arunachal Pradesh	104	0.08	55	0.0
4	Assam	3,956	2.9	882	0.5
5	Bihar	10,817	7.93	9,818	5.2
6	Chandigarh	16	0.01	45	0.0
7	Chhattisgarh	3,762	2.76	1,567	0.8
8	D & N Haveli	4	0		0.0
9	Daman & Diu	1	0	1	0.0
10	Goa	44	0.03	57	0.0
11	Gujarat	10,165	7.46	14,493	7.7
12	Haryana	3,045	2.23	10,726	5.7
13	Himachal Pradesh	1,301	0.95	1,460	0.8
14	J & Kashmir	1,633	1.2	2,540	1.4
15	Jharkhand	3,893	2.86	2,183	1.2
16	Karnataka	5,734	4.21	7,901	4.2
17	Kerala	698	0.51	2,548	1.4
18	Lakshadweep	1	0	4	0.0
19	Madhya Pradesh	12,637	9.27	15,911	8.5
20	Maharashtra	9,018	6.61	11,655	6.2
21	Manipur	86	0.06	86	0.0
22	Meghalaya	336	0.25	87	0.0
23	Mizoram	22	0.02	26	0.0
24	Nagaland	24	0.02	73	0.0
25	Nct of Delhi*	0	0	0	0.0
26	Odisha	3,346	2.45	2,311	1.2
27	Puducherry	38	0.03	49	0.0
28	Punjab	3,800	2.79	12,599	6.7
29	Rajasthan	13,835	10.15	23,668	12.6
30	Sikkim	68	0.05	61	0.0
31	Tamil Nadu	5,081	3.73	8,362	4.5
32	Telangana	3,679	2.7	5,416	2.9
33	Tripura	306	0.22	185	0.1
34	Uttar Pradesh	24,938	18.29	30,519	16.3
35	Uttarakhand	1,318	0.97	1,792	1.0
36	West Bengal	7,466	5.48	5,607	**3.0**
	All India	1,36,332	100	187,749	100.0

Source: Livestock Census, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture & Farmers' Welfare, GoI

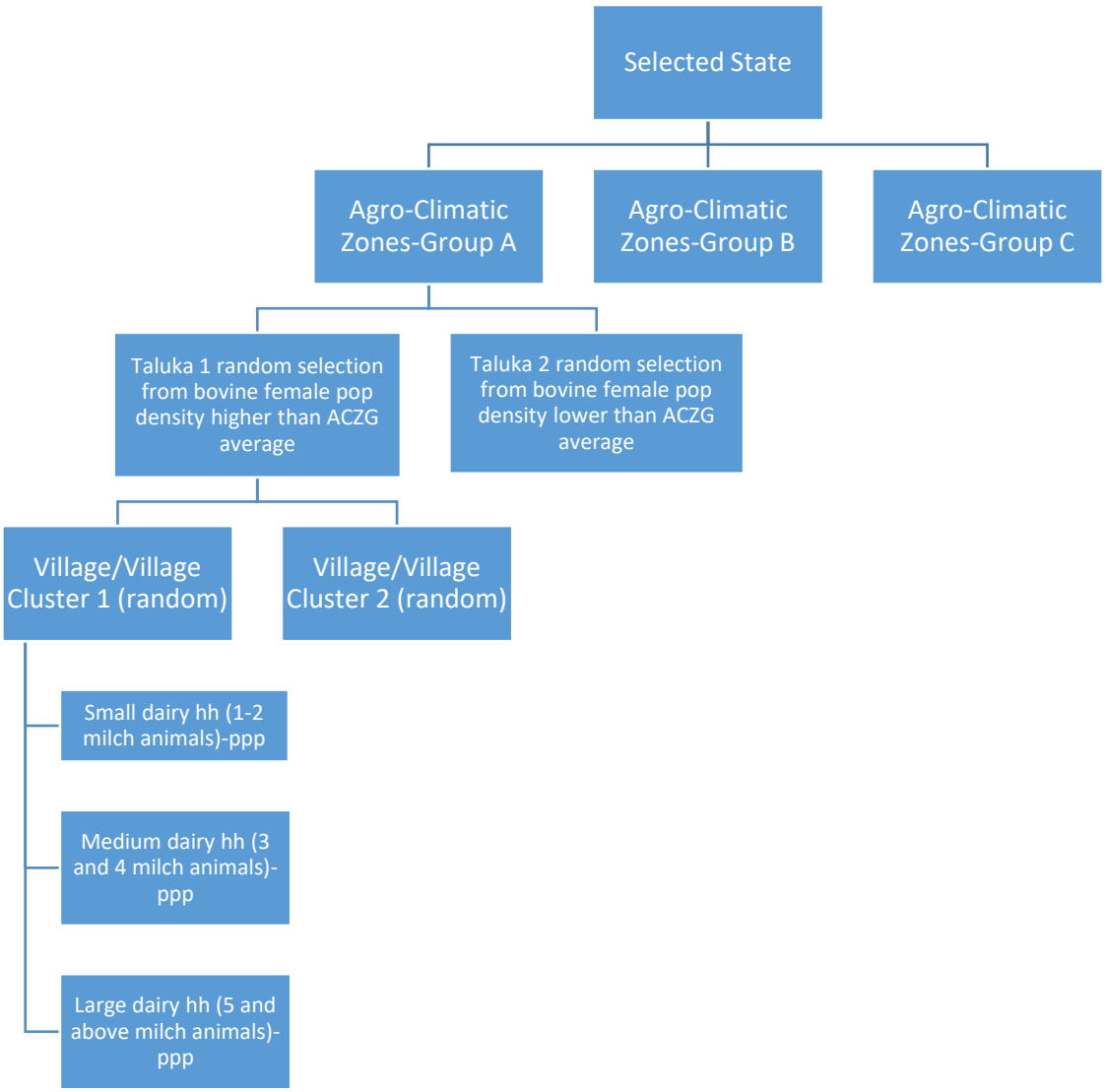
1.5 Survey Design

1.5.1 Sampling Framework

The multistage stratified random sampling method was used to select the sample dairy households.

Selection of Agro-Climatic Zones

The first stage involved selecting the different Agro-Climatic Zones present in the state. Every state is divided into different agro-climatic zones. In order to capture the variability in the zones, the agro-climatic zones in each state are combined into three groups that are relatively similar in nature.



Selection of Tahsils:

The second stage involved selecting talukas/Mandals/Blocks. From each of Agro-Climatic Zone Group (Group A, B & C), two talukas/Mandals/Blocks were selected on the basis of density of female bovine population (cattle and buffalo), i.e. one taluka was selected randomly from a group of talukas having a density higher than the ACZ Group and another taluka were selected randomly from a group of taluka as having a density less than ACZ Group.

Selection Procedure of Talukas using PPS

1. All the talukas/mandals/blocks in each state were arranged under the respective group of Agro-Climatic Zone. To ensure variation in ACZs, three groups of ACZs will be prepared to ensure relative similarity. Accordingly, a list of talukas in each state was prepared into three broad ACZ groups to account for variability.
2. For each taluka, the number of adult female bovine (cow and buffalo) population was taken from the Livestock Census 2019.
3. For each group of ACZ, the taluka-wise female bovine population was totalled as a group total.
4. The taluka-wise density, as well as the density of each ACZ Group of female bovine population (number of total female bovine population/number of villages), was estimated.
5. On the basis of the ACZ Group density figure, one taluka was selected randomly from a group of talukas having a density higher than the ACZ Group and another taluka was selected randomly from a group of talukas having a density less than the ACZ Group.
6. From randomly selected taluka, two villages (having a female bovine population more than density of takula) were selected randomly.

Selection of Village/ Village clusters:

The third stage is the selection of Villages. From the selected taluka/taluk, two villages (having a female bovine population more than the density of the taluka) were selected randomly.

Selection of Milk Producers:

A. In each selected village, a list of households having in-milch animals (cow and buffalo) on the survey date would be prepared (on the day of visit to the village).
B. The animals that had at least calved once were included, while unproductive animals were excluded from the population.
C. Thus, the total sample size of milk producers in the State would be 240. The milk producers were categorized as follows according to their ownership of the number of bovine populations in milch (cattle and buffaloes)
    - *Small Milk Producers (1-2 milch animals),*
    - *Medium Milk Producers (3-4 milch animals)*
    - *Large Milk Producers (5 Milch animals and above)*
D. From each village, 20 dairy households/milk producers were selected randomly on the basis of probability proportionate to the number of households in each category in the village.
E. Thus, total sample in each taluka is selected 40 from two villages and total 80 in ACZ Group.

Table 1.2: Sampling Framework

State	State (n=240)											
ACZ	ACZ Group A (n=80)				ACZ Group B (n=80)				ACZ Group C (n=80)			
Tahsil	Taluka 1		Taluka 2		Taluka 1		Taluka 2		Taluka 1		Taluka 2	
Village	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12
Milk Producer	20	20	20	20	20	20	20	20	20	20	20	20
FGD	1	1	1	1	1	1	1	1	1	1	1	1
Total	Milk Producers -240, Focus Group Discussion-12											

Following all the above steps, the sample blocks and villages are as follows:

Table 1.3: Sample Blocks and Villages in West Bengal

ACZ Groups	WEST BENGAL		
	District	Taluka	Village
ACZ Group I	Coochbehar	Mathabhanga - II	Dumniguri
			Panikhawa
	Kalimpong	Kalimpong -I	Icha Khasmahal
			Yang Makum Khasmahal
ACZ Group II	24 Paraganas South	Kakdwip	Manmathapur
			Sitarampur
	Birbhum	Rampurhat-II	Santoshpur
			Paikpara
ACZ Group III	Purba Bardhaman	Manteswar	Bara Kalmi
			Kalui
	Bankura	Sarenga	Bamandiha
			Tapaberia

1.5.2 Development of Survey Schedule

The survey schedule for collecting primary data was developed. Two types of survey schedules were canvassed in the study area:

- **Focus Group Discussion (FGD):** Before primary data collection, 12 FGDs were conducted in each village cluster (12 FGDs in one State – so one in each village). Details were asked included certain aspects such as the current practice of replacing animal in the farm for cows and buffaloes separately - cost of induction of animals at first calving, selling price at the end of productive life, and method of disposal of old animals after productive life; in case if farmer was rearing calf for selling, then cost of rearing as well as selling price of calf to be captured; lactation length in months; average number of lactation in the life time of animals; age at first heat (in months); age at first calving in months; average inter-calving period in months; salvage value by animal type either local cow or cross breed or buffalo; average productive life of animal in years; average consumption of feed and fodder by cows and buffaloes (season-wise and variety-wise, when in lactation and when dry); dividend received from dairy society (Rs./litre); agriculture season; cattle shed land cost; milk price[4] offered by different agencies, etc. The purpose of FGD is to get a clear idea of the expected responses in the questionnaire, so that a clear picture of data collection can be formed and, simultaneously, reasons for

[4] In case of DCS, milk rate includes per litre rate paid plus support/bonus and or profit shared.

some outliers can be identified. It is important to note that no female buffaloes have been included in our sample, and there is no scope to purchase livestock or build a cattle shed by taking loans from the co-operative credit society.

Before entering the second stage, i.e., the household survey, 20 households from each village have been proportionately selected using the available list of Pranimitra or AI workers and based on the average livestock holding of that village.

- **Dairy Owners:** for collecting detailed information about milk production from the sample dairy member households.

1.6 Data Analysis

Analytical tools like tabular analyses and graphical plots are used to present the data effectively in the report. Statistical Software such as 'MS Excel' and 'Stata' are used for analysing the data. To achieve the objectives of the study, the following operational definitions, methods or procedures were used.

1.6.1 Components of Costs in Milk Production

To analyse the cost of milk production in the dairy farming sector, the first step is to determine the components of the milk production system's costs. The cost structure of milk production can be classified according to the fundamental theory of costs in the school of Economics: Total Cost (TC) = Total Fixed Cost (TFC) + Total Variable Cost (TVC).

1.6.2 Operational Expenses/ Variable/Paid out /Direct Cost

In order to analyze the operational expenses/variable cost/paid out cost/direct cost in dairy farming and to compute the break-even output of milk for cows and buffaloes, the following details were tabulated.

i) *Feed Cost:* The cost incurred on the green fodder, dry fodder, concentrate and food supplements to feed the animals constitutes feed cost. It was calculated by multiplying quantities of feed and fodder consumed by animals by the respective prevailing market price for feed and fodder in the sample households. Seasonal variations, lactation, or dry variations will be captured separately for three seasons, then averaged to obtain total consumption. Also, fodder consumption of in-milk and dry animals was adopted during the visit to each household. In case all animals were fed together, the joint cost of feed was apportioned by applying

the standard animal units approach (by using Ghule et al, 2012; Bairwa et al., 2016).

ii) *Labour Cost:* It includes family labour as well as paid hired labour. The hired labour cost was calculated based on the time utilised for various dairy activities and the wages paid. In the case of family labour, the prevailing casual labour wage rate in the study area was considered.

iii) *Veterinary Cost:* It includes the annual cost incurred on natural service, Artificial Insemination (A.I.), vaccination, de-worming, medicines and other charges/fees of veterinary doctors.

iv) *Insurance Premium paid*[5]*:* Payment made towards insurance of animal (Rs. /animal / per annum).

v) *Miscellaneous Costs:* The cost of water charges, electricity, repairs of machines, buckets, transport costs, rope, etc., is included in this cost.

1.6.3 Fixed Cost

In dairy farming, there are several fixed costs that farmers should incur to set up milk production activities. The most important component of these one-time costs is as follows.

i) *Cost of the animal*: The most important fixed cost to milk production is the cost incurred to purchase the milch animal in dairy farming. This is a one-time investment a farmer must make to start farming.

ii) *Cost of the cattle shed, productive assets and equipment: Another crucial costs that have to be incurred to start up a dairy activity is the cost of the cattle shed, assets and* dairy equipment. This is another kind of one-time cost needed to start up dairy production.

In the cost of milk production, the fixed cost contributed to day-to-day transaction costs through depreciation of the total fixed assets. The study has estimated day-to-day depreciation costs using the following methodology.

(a) In the estimation of the depreciation of cattle animals, the cows have been graded according to lactation order. The study followed the Sivakumar (1993) and Ghule et al. (2012) criteria, i.e., lactation periods I, II, and III are not depreciated for the cow. For the lactation order over III, the study followed the depreciation rate indicated in Box 1.1.

[5] Lal and Chandel , 2016

Box 1.1: Depreciation Rate for Dairy Animals (present value)

Particulars	Depreciation rate (%) IV & Vth lactation	Depreciation rate (% per lactation) VI lactation and above
Local Cow	8	20
Crossbred Cow	8	20

(b) The depreciation rate for cattle shed and other dairy equipment is given in Box 1.2.

Box 1.2: Depreciation Rate for Buildings and Dairy Equipment's

Particulars	Depreciation rate (% per annum)
Pucca building	2
Semi-pucca building	5
Chaff cutter	5
Dairy equipment-Milk cans and petty items	5

(c) The study sets up the methodology to calculate the depreciation of interest rate on borrowings on fixed capital at the rate of 8.80 per cent (MCLR[6] + 0.10%) but the study has not found any such kind of borrowing in the sample area of West Bengal.

1.6.4 Estimation of Opportunity Cost

Opportunity cost is the cost of giving up something to get something else. To explore the difference between opportunity costs of dairy enterprise vis–à–vis prevailing market rate of feed-fodder, labour and other equipment and its impact on breakeven analysis, with and without comparison, is done, having considered the imputed value of factors of production (also, home fodder & family labour). While wages under MGNREGA were also obtained, considered, and compared, wages prevailing in the same village during the same period were found most appropriate for calculations and were thus included in the analysis.

1.6.5 Estimation of Association between Dairy and Rural Households

To explore whether dairy production is strongly and positively associated with improvements in rural livelihoods, in terms of income, across all groups, the selected households were asked to provide details of their sources of annual gross income for the agricultural year 2018-19. The Pearson Correlation Coefficient between household dairy income and total income was

[6] https://rbidocs.rbi.org.in- calculated average of twelve-month rate of interests for June 2018 to May 2019)

estimated to assess the association between dairy income and its role in rural livelihoods. The formula used was as described below:

$$r = \frac{N\sum XY - (\sum X)\,(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

N= Number of pairs of scores

$\sum XY$= Sum of the products of paired scores

$\sum X$= Sum of X scores

$\sum Y$= Sum of Y scores

$\sum X^2$= Sum of squared X scores

$\sum Y^2$= Sum of squared Y scores

1.6.6 Estimation of Weighted Average

Where-ever DCS member had sold milk to more than one agency, weighted average of price was estimated by using following formula.

Weighted Average= $(\sum W_i X_i)/ \sum W_i$

Where, Xi = Weighted value of an item, Wi = Weight of Xi such as sale of milk

1.6.7 Estimation of Break-Even Point

The studies on the approach and methodologies for the breakeven point of dairy enterprises were reviewed. The purpose of break-even analysis is to provide a reasonable estimate of the impact of marketing activity on earnings. The break-even level, or break-even point, is the sales volume, in either units or revenue terms, required to cover total costs (both fixed and variable). Profit at break-even is zero. Break-even is possible only if a firm's prices exceed its variable costs per unit. If so, then each unit of the product sold will generate some "contribution" toward covering fixed costs. In economics and business, specifically in cost accounting, the Break-Even Point (BEP) is the point at which costs and expenses equal revenue: there is no net loss or gain, and one has "broken even." A profit or a loss has not been made, although opportunity costs have been "paid," and capital has received the risk-adjusted, expected return. In short, all costs are borne by the firm, and the profit is zero (Mahmoodieh et al., 2014; Gamechu & Meskel, 2019).

Break-even point in litres of milk BEP $_{\text{Milch Animal}}$ = TFC_{MA} / (ASP_{MA}- AVC_{MA})

Where, BEP_{MA} = Break-even point in litres of milk.

TFC_{MA} = Total fixed cost per milk animal in rupees (lactation or cycle).

ASP_{MA} = Average selling price per litre of milk (Rs.).

AVC_{MA} = Average variable cost per litre of milk (Rs.)

Accordingly following variety of BEPs have been estimated.

Table 1.4: Variety of BEPs in West Bengal

BEP calculations	A variety of animals	at market price (Paid-out Cost)	Opportunity Cost
For the lactation period	Local cow	BEP (LC, MP)	BEP (LC, OC)
	Cross-bred cow	BEP (CB, MP)	BEP (CB, OC)
	Buffalo	BEP (B, MP)	BEP (B, OC)
For whole cycle	Local cow	BEP (LC, MP)	BEP (LC, OC)
	Cross-bred cow	BEP (CB, MP)	BEP (CB, OC)
	Buffalo	BEP (B, MP)	BEP (B, OC)

Considering no imputed cost of family labour, BEP was also estimated per day as well as for lactation and cycle periods.

BEP provides only the quantity of milk during the lactation/dry period to cover fixed costs (as variable costs are already covered directly by the sale price). Thus, when variable cost exceeds the selling price, BEP cannot be estimated. Thus, the level of BEP can also be reached by estimating

- Total Cost = Total Revenue
- BEP Actual = (TC in lactation or cycle period / TR per litre)

1.6.8 Margin of Safety

The study is also deployed the concept of 'Margin of Safety' (MoS) to determine the risk position of the milk producers. The 'Margin of Safety (MoS)' is the difference between aggregate total sales from the 'Break Even Sales (BES)', i.e.

$$\text{Margin of Safety (MoS) Ratio (\%)} = \frac{\text{Agrregate Actual Sale} - \text{Break Even Sale}}{\text{Agrregate Actual Sale}} \times 100$$

A high MoS ratio indicates actual production is above the BEP level, and vice versa. The production level excess over the BEP margin is the power of producers to prevent the production unit from sudden, unforeseen shocks. As a result, a milk-producing unit will

always prefer to maintain a higher margin of safety in order to protect the production system from short-term shocks.

1.6.9 Sensitivity Analysis

The dairy farm business has several feasible options that can have a positive impact, all of which are very sensitive to changes in milk prices, milk yield, and variable costs. To suggest suitable measures for sustainable dairy growth, a Sensitivity Analysis was conducted across six scenarios. A sensitivity analysis determines how different values of the selected independent variable affect a particular dependent variable under a given set of assumptions[7]. This model is also referred to as a 'what-if' or 'simulation analysis'. The tool helps in answering the question: "What if…?" or "What would happen if?" What if our cost decreases or milk yield increases by a certain percentage? What if the cost of an input changes? What if the family labour is not considered? This technique quantifies the outcome of a change in a single variable or a combination of selected variables that can affect the dairy enterprise profitability. It can be used to identify the critical variables and their effect on projected profitability. Sensitivity analysis allows for forecasting using true data. By studying all variables and possible outcomes, important decisions can be made about businesses, the economy, and investments.

Conducting sensitivity analysis provides a number of benefits for decision-makers. First, it acts as an in-depth study of all the variables. Because it's more in-depth, the predictions may be far more reliable. Secondly, it allows decision-makers to identify where they can improve in future. But there are some disadvantages of using such a model. The outcomes are all based on assumptions because the variables are all based on data already collected. Hence some caution is advisable while applying the analysis for future predictions.

For the current study, sensitivity analysis will be undertaken using following scenarios:

1. Scenario I: Decrease in fodder cost by 5% & increase in milk yield by 5%
2. Scenario II: Only decrease in fodder cost by 5%
3. Scenario III: Only increase in milk yield by 5%

[7] Reddy and Ram (1996); Becker et. al. (2007).

1.6.10 Constraints Analysis

To examine the constraints faced in milk production and feeding management, selected households were asked to rank the listed constraints (Box 1.3), which were then further analysed.

Box 1.3: Constraints in Milk Production and Feeding Management

Sr. No.	Milk Production- Constraints	Sr. No.	Feeding Management -Constraints
1	High Feed cost	1	Unavailability of green/ dry fodder throughout the year
2	Non-Availability of Fodder	2	The majority of grazing lands are either degraded or encroached
3	High price for milch animal	3	Irregular & inadequate supply of cattle feed by PDCS
4	Low average milk yield of the milk animals	4	Non-availability of improved fodder seed in the market / PDCS
5	Low milk price (Rs. /lit)	5	High cost of cattle feed and mineral mixture
6	High cost of veterinary medicines	6	No provision of quality seed on credit
7	Lack of nutritious feed for quality milk production	7	High Cost & Low return on fodder production
8	Poor knowledge about feeding and healthcare	8	Diversion of feed and fodder ingredients for industrial use
9	Lack of finance to invest in dairy business for quality milk prod/Inadequate finance	9	Lack of necessary space required for tying the milking animals/ Poor housing
10	Lack of veterinary services in villages for quality milk production	10	Land is very less therefore cannot afford to put more land under fodder seed/crop production

1.7 Organization of Report

The report consists of six chapters. The current chapter i.e., chapter-1 is the introductory part and chapter-II will elicit the profile of sample households. The chapter-III represents cost of milk of production and Sensitivity Analysis, while chapter-IV is about Break-even Analysis. Chapter-V focuses on several constraints of milk production and feeding management. The last chapter-VI consists of summary and conclusion including policy suggestion.

Chapter II

Profile of Selected Dairy Households in West Bengal

2.1 Introduction

One of the major objectives of this study is to assess the socio-economic profile of selected dairy households. This chapter is designed to serve this purpose and we will see how socio-economic variables like Gender, Education of Household head, caste, religion etc., are distributed across different types of milk producers i.e., small, medium and large.

2.2 Profile of Selected Households

By adapting the probability Proportionate Sampling method in the following Table 2.1, it is observed that out of the total 240 samples, 230 fall under small types of milk producers, i.e., those with holdings of 1-2 milch animals, whereas 9 households fall under the medium type, i.e., having 3-4 milch animals. But it is important to note that only one household out of the total sample is of the large type, i.e., having more than four milch cows. It reveals that if we consider our sample representative of West Bengal, above 95 per cent of the sample dairy farmers are smallholders, showing either reluctance toward cow rearing or not considering this culture in a commercial manner.

It is also observed that most of the sample households are headed by a male member, which is not very unusual in the case of rural Bengal. It is noticed that all the households under the medium and large categories are headed by male members. It is interesting to note that in the case of small milk producers and the overall sample, if we consider the mean age of the household head, it is observed that the mean age of the female head is higher compared to the male head, which implies that more aged female-headed households are engaged in dairying activities.

In case of average education level of household head, it is observed that approximately half of the total sample falls under the secondary level, followed by the primary level and the illiterate, respectively. Only one household have Post-Graduate degree is falling under the large milk producers' category. The story is almost the same for the small holding category, but in the case of medium holding, it is found that over 60 percent are of secondary level followed by illiterate, which reveals most of the sample milk producing households are guided by the head who has a moderate level of education.

Table 2.1: Family Profile of Selected Households

Sr. No	Particulars	Family Profile of Selected Households			
		Small	Medium	Large	Overall
n=		230	9	1	240
1	Gender of HH (%)				
	Male	97.4	100	100	97.5
	Female	2.6	0	0	2.5
2	Age of HH (Year)				
	Male	52.4	49.8	65	52.8
	Female	58.7	0	0	58.2
3	Education of respondent/HH (%)				
	Illiterate	17.8	11.1	0.0	17.5
	Literate but no formal education	8.3	0.0	0.0	7.9
	Primary	22.6	0.0	0.0	21.7
	Secondary	43.0	66.7	0.0	43.8
	Higher Secondary	4.8	22.2	0.0	5.4
	Graduate	3.5	0.0	0.0	3.3
	Post Graduate	0	0	100	0.4
4	Av. Household Size (Nos.)				
	Male	2.1	2.5	2.0	2.2
	Female	1.9	2.8	1.0	1.9
	Children(Below 15 Year)	1.0	1.0	0.0	1.0
	Total	5.0	6.3	3.0	5.1
5	Family members works in dairy (Nos)				
	Male	1.2	2.1	1.0	1.3
	Female	1.2	1.7	0.0	1.2
	Children(Below 15 Year)	0.0	0.1	0.0	0.0
	Total	2.5	3.9	1.0	2.5
Source: Field Survey Data		Note: HH- Household			

It is also found that the average household size for the overall sample is 5.1, higher than the state average. For medium milk producers, it becomes the highest, followed by small and large producers, respectively. The average male member in sample households is higher than the average female member for small and large milk producers, and this is opposite in medium milk producers. Average number of children in a family is almost 1 across all groups.

It is also found that the average number of family members engaged in dairy activity is almost half of the average household size for the overall sample, i.e. 2.5. For the small milk producers engagement of male and female member in dairy is same, while engagement of male member is higher compared to female member for medium milk producers and for overall sample. It is also seen that total engagement in dairy activities is quite higher for

medium milk producers than small milk producers. For only one large sample only the male member is engaged in dairy.

Table 2.2: Socio-Economic Characteristics of Selected Households

Sr. No	Particulars	Socio-Economic Characteristics of Selected Households			
		(N=240)			
		Small	Medium	Large	Overall
1	Religion (%)				
	Hindu	76.5	100.0	0.0	77.1
	Muslim	22.6	0.0	100.0	22.1
	Christian	0.0	0.0	0.0	0.0
	Sikh	0.0	0.0	0.0	0.0
	Other	0.9	0.0	0.0	0.8
2	Social Group (%)				
	Scheduled Tribe	3.0	0.0	0.0	2.9
	Scheduled Caste	30.0	55.6	0.0	30.8
	Other Backward Class	21.7	0.0	0.0	20.8
	General/Open	45.2	44.4	100.0	45.4
3	Income Group (%)				
	BPL	37.4	33.3	0.0	37.1
	APL	54.8	66.7	100.0	55.4
	AAY	7.8	0.0	0.0	7.5
4	Have Facility at home (%)				
	Biogas	0	0	100	100
Source: Field Survey Data					

In Table 2.2, the distribution of religion and caste income groups is shown across all types of milk producers. It is found that in the case of religion, Hindu dominates significantly over all other religions, followed by Muslims for the overall sample, implying Hindus' usual religious tendency to rear cows and use domestic milk. This story is the same for small milk producers, while all medium producers belong to the Hindu religion, and only one large producer is Muslim. It is also important to note that only two households in the hilly region are Buddhist.

The caste distribution shows that the general caste dominates all other castes. Almost half of the total sample belongs to general classes, followed by Schedule caste and OBC, respectively. The story is the same for small milk producers as well. But in case of medium

milk producers, schedule caste dominates over general class, while only large producer is of general class, although the family is Muslim.

It is found in the distribution of Income group that more than half of sample household is becoming from Above Poverty Level (APL), followed by Below Poverty Level (BPL) families. It is also important to mention that only 7.5 percent of total sample falls under Antyodaya Anna Yojna (AAY) possibly implying that if we consider income distribution more than half families of the sample having APL card with moderate economic condition. The story is similar when we see this income distribution across different milk producing classes. It is also seen that only one household has the bio-gas facility, and it is the only large farmer.

Table 2.3 presents the details on occupation and landholding size of the selected dairy farming households. It is observed in the following table that the principal occupation of the household head is cultivation for more than half of the sample households, followed by own non-farm establishment and animal husbandry and dairying. The story is almost the same for both small and medium producers, suggesting that a common tendency to engage in agricultural activities can be considered the principal occupation. For medium producers' cultivation as the principal activity is reported very high, i.e. almost 78 percent of total medium producers. The only large milk producer is a pensioner, but is also actively involved in the agricultural activities, hence falls under the cultivation as principal occupation.

In the case of subsidiary occupation, animal husbandry and dairy are the most dominant, followed by cultivators, with no other subsidiary income sources, implying dairy activity as a moderate source of income. The story is quite similar for both small and medium holders, while the only large holder has a subsidiary occupation in animal husbandry and dairying.

Land is considered an important physical asset to any household. It is observed that, overall, approximately 80 per cent of households have their own cultivable land, while the remaining are landless. If we consider small milk producer and medium milk producers the figures appeared 78.8 and 88.9, simply states a well distributed land holding status of the sample households.

Table 2.3: Details on Occupation and Land Holdings Size of Selected Households

Sr. No	Particulars	Occupation and Land Holdings Size of Selected Households (N=240)			
		Small	Medium	Large	Total
1	Occupation (%)				
	Principal				
	Cultivator	57.4	77.8	100.00	58.3
	AH & Dairying	9.1	0.0	0.0	8.8
	Agri. Labour	8.7	0.0	0.0	8.3
	Nonfarm Labour	4.4	0.0	0.0	4.2
	Own Non-Farm Establishment	13.9	22.2	0.0	14.2
	Trade	NA	NA	NA	NA
	Employee in Service	1.3	0.0	0.0	1.3
	Other	5.2	0.0	0.0	5.0
	Subsidiary				
	No Subsidiary Sources	18.3	11.1	0.0	17.9
	Cultivator	18.7	22.2	0.00	18.8
	AH & Dairying	35.2	33.3	100.00	35.4
	Agri. Labour	13.0	11.1	0.0	12.9
	Nonfarm Labour	5.7	22.3	0.0	6.3
	Own Non-Farm Establishment	7.8	0.0	0.0	7.5
	Trade	NA	NA	NA	NA
	Employee in Service	0.4	0.0	0.0	0.4
	Other	0.9	0.0	0.0	0.8
2	Households having land (% to total)	78.7	88.9	100.0	79.2
3	Landless hh (% to total)	21.3	11.1	0.0	20.8
4	Total Operational land holding (Av. area in ha) [*only for 206 farming HH*]	0.63	1.33	3.24	0.67
Source: Field Survey Data		* Not mentioned in questionnaire			

The average operational landholding is found to be 0.67 hectares for the overall sample and 0.63 hectares and 1.33 hectares for small and medium holders, respectively. The operational seems to be high for the large holder as he is the only sample in this category.

2.3 Herd Strength

Table 2.4 describes the herd strength of the sample units. It is found that for the small holders' total number of local breeds milch animals are 146, out of which 92 are in milk not pregnant, 18 are in milk pregnant, 33 are dry and pregnant, 3 are dry and not pregnant. It is also seen that for the small holders' total number of local breeds milch animals are 134, out of which 69 are in milk not pregnant, 28 are in milk pregnant, 34 are dry and pregnant, and 3 are dry and not pregnant.

Table 2.4: Herd Strength of Selected Households (No. of Animals/household)

Sr. No.	Particulars	In milk		Dry		Heifer		Calves		Total Adult Male	All Animals	Milch Animals	Insurance (milch animals)	
		In milk not Pregnant	In milk and Pregnant	Dry and pregnant	Dry and not Pregnant	Not Calved even once	Pregnant Heifer	Male	Female				Nos	Amount
a	Small													
	Local Cattle	92	18	33	3	62	13	50	53	59	383	146	0	0
	Cross Bread	69	28	34	3	60	22	52	50	11	329	134	1.7 (6)	245
	Buffalo	0	0	0	0	0	0	0	0	4	4	0	0	0
	Total	161	46	67	6	122	35	102	103	74	716	280	1.7 (6)	245
b	Medium													
	Local Cattle	6	1	7	2	4	1	4	3	8	36	16	0	0
	Cross Bread	10	1	2	2	3	1	4	6	2	31	15	1 (1)	300
	Buffalo	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	16	2	9	4	7	2	8	9	10	67	31	1 (1)	300
c	Large													
	Local Cattle	7	0	0	2	1	0	6	1	2	19	9	0	0
	Cross Bread	0	0	0	0	0	0	0	0	0	0	0	0	0
	Buffalo	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	7	0	0	2	1	0	6	1	2	19	9	0	0
d	ALL													
	Local Cattle	105	19	40	7	67	14	60	57	69	438	171	0	0
	Cross Bread	79	29	36	5	63	23	56	56	13	360	149	1.6 (7)	253
	Buffalo	0	0	0	0	0	0	0	0	4	4	0	0	0
	Total	184	48	76	12	130	37	116	113	86	802	320	1.6 (7)	253
Source: Field Survey Data														

It is also observed that heifers are higher for crossbreed, while calves are almost the same for both breeds. It is important to mention that we get 4 adult male buffaloes in the sample. It is also seen that for the small milk producers out of total 716 animals 280 are milch, while total adult male is higher for local cattle. For the medium holder out of 67 animals 31 are milch, while 10 are adult male. Cross breed and local milch cows are almost same for medium holders. For the only large milk producers total herd strength is 19, out of which 9 are milch. For overall sample it is found that no of local breed milch is higher than cross breed milch i.e. 171 local breed milch and 149 cross breed milch is there. It is also observed that across all

breeds for overall sample all animals are 802, out of which 320 are milch animals. It is also found that 7 cross breed cows are ensured under Insurance policy with average value of 253 Rs for overall sample, out of which 6 are in small category with the value 245 and 1 in medium category with the value 300.

Table 2.5: Details on Cattle Shed of Selected Dairy Households

Sr. No.	Items	Small			Medium			Large			Overall		
		Av. No. /HH	Value /shed (Rs.)	Av. Life (years)	Av. No. /HH	Value /shed (Rs.)	Av. Life (years)	Av. No. /HH	Value /shed (Rs.)	Av. Life (years)	Av. No. /HH	Value / shed (Rs.)	Av. Life (years)
1	Pucca												
	Owned fund	1 (64)	44914	8.8	1 (6)	57105	16	1 (1)	41912	10	1 (71)	45902	9.4
	Borrowed fund	1 (2)	98562	1.5	0	0	0	0	0	0	1 (2)	98562	1.5
	Subsidy received	1 (4)	25871	4.75	0	0	0	0	0	0	1 (4)	25871	4.75
2	Kachcha												
	Owned fund	1 (160)	10579	9	1 (3)	8024	17	0	0	0	1 (163)	10532	9

Source: Field Survey Data
*Present value calculated with 5% depreciation rate as most of the cattle sheds are semi-pucca in nature, entried as pucca.

Table 2.5 above presents the details of the household's cattle shed. It is found that 71 households have their own funded pucca cattle sheds, while 2 households have borrowed funds, and 4 have cattle sheds built with a subsidy received. Out of the total 71 pucca own-funded cattle sheds, 64 falls under small milk producers, 6 under medium milk-producing households, and 1 under large holders. The average holding of own-funded pucca cattle shed per household is 1, with the present value of Rs 44914 (depreciated at a 5% rate). The figure turns out to be Rs 98562 for borrowed funds and Rs 25871 for a cattle shed made under subsidy. For the medium holder, the present value of the cattle shed is higher than for the small holders. (Rs 57105). It is also found that the average life of the pucca-owned cattle shed is 9.4 years, while it is 1.5 and 4.75 years for cattle sheds made upon borrowed funds and subsidy, respectively, for the overall sample. For the small holders, the value is 8.8 years, and for the medium holders, it is 16 years.

A total of 163 households has their own funded kaccha cattle shed with a present value of RS 10532 and an average life of 9 years. This figure becomes 160 and 3 with the present value Rs 10573 and Rs 8024 for the small and medium milk producers, respectively. The average life of the kaccha cattle shed is 9 years for the small holders and for the medium holders it becomes 17 years that reveals in case of any type of cattle shed the present value and average

life is higher for medium holders. Average holding of kaccha cattle shed is 1 per household for the overall sample. The only large milk producer have a pucca cattle shed with the present value of Rs 41912 and average life of 10 years.

Table 2.6: Fodder Storage with Selected Dairy Households

Sr. No.	Items	Small			Medium			Large			Overall		
		Av. No. /HH	Value /shed (Rs.)	Av. Life (years)	Av. No. /HH	Value /shed (Rs.)	Av. Life (years)	Av. No. /HH	Value /shed (Rs.)	Av. Life years)	Av. No. /HH	Value /shed (Rs.)	Av. Life years)
1	Pucca												
	Owned fund	1 (10)	8104	13	1 (1)	5987	10	0	0	0	1 (11)	7911	12.7
	Borrowed fund	1 (1)	16290	4	0	0	0	0	0	0	1 (1)	16290	4
	Subsidy received	0	0	0	0	0	0	0	0	0	0	0	0
2	Kachcha												
	Owned fund	1 (21)	3734	7.6	0	0	0	1 (1)	27934	7	1 (22)	4835	7.6
Source: Field Survey Data *Present value calculated with 5% depreciation rate, as most of the fodder storage is semi-pucca in nature, entered as pucca.													

In a previous manner, the details of the fodder storage are depicted in Table 2.6. It is found that the holding of the fodder storage per household is 1, with different present values in all cases. For the overall sample, the 11 households have their own funded cattle shed with the present value of Rs 7911 and an average life of 12.7 years. For the borrowed fund, the figure turns out to be Rs 16290 with an average life of 4 years. But there are no cases in terms of subsidy-funded cattle sheds. For smallholders, there are 10 households with their own funded pucca fodder storage, with a present value of Rs 8104 and an average life of 13 years, while for borrowed funds, the present value is Rs 16290 with an average life of 4 years. For one single sample in the medium category, the present value is Rs 5987 with the average life of 10 years. 22 households have their own funded kaccha fodder storage with the present value of Rs 4835 and an average life of 7.6 years. Out of the total sample, 21 small milk producers have one fodder storage with a present value of Rs 3734 and an average life of 7.6 years. The only large producers have a single fodder storage with a present value of Rs 27934 and an average life of 7 years. In a nutshell, it is observed that the present value of any type of cattle shed is higher than the present value of fodder storage, and the average productive life is lower for a cattle shed than for fodder storage.

The following Table 2.7 presents the holdings of productive milking assets by sample households, along with their average holding, present value, and average productive life. It is

important to note that the Present value is calculated using a 5% depreciation rate. It is found in all the sample households that there is not any large milk cans are used to milking the cows. Rather small capacity domestic tools made by aluminium or steel (even some cases plastic) of 5 litres are used to milk the animal. For the overall sample the average holding the milk cans is 1. With the average productive life of 3.5 years and present value of Rs 216. It is also found that average holding of milk cans is increasing across the milk producers i.e. holding is higher for large producers than medium and small. In our sample there are no such cases where milking machine is used to milk the animal.

There are 202 households that use a grass cutter to cut the grass for their animals. Generally, they use it for all domestic purposes. The average holding of a grass cutter is 4, with the present value of Rs 95. A slight increase in the size of the producer is observed. In 5 household fodder chaffers, power has been obtained at a present value of Rs 18133 and an average productive life of 8 Years. There are 221 households with a feed mixture, and their holdings show an increasing pattern across types of milk producers. 195 households out of the total sample have a grass chopper, and it is found that holding of a grass chopper is higher for medium milk producers than for small milk producers, while large producers do not have a grass chopper. 29 households have fan as a milking asset and they all are under small category.

Only the large producers have biogas unit of present value Rs 60016. 190 households have feed container to feed their animals and it’s per household holding is increasing across milk producing category, which is very usual.

Table 2.7: Holding of Productive Assets by Selected Dairy Households

Sr. No	Assets per household	Productive Assets/ household (Average)			
		No./ HH (Total No.)	Value (Rs.)	Life (years)	Subsidy received if any with the year (Rs./unit)
A	**Small**				
1	Milk cans (aluminium / steel) 5 lit	1.3 (230)	217	3.5	0
2	Milking Machine	NA	NA	NA	NA
3	Grass Cutter	2 (194)	120	2.7	0
4	Fodder Chaffer-Manual	NA	NA	NA	NA
5	Fodder Chaffer Power	1 (4)	18475	7.5	0
6	Fodder Harvester/mowers	NA	NA	NA	NA
7	Feed Mixer	1.3 (212)	466	5	0
8	Grass Chopper	1.1 (188)	330	6	0
9	Fan, Fogger	1.1 (29)	975	3.4	0
10	Biogas unit	NA	NA	NA	NA
11	Tractor Trolly	1	2096	10	0
12	Others (Feed Container)	2.6 (182)	327	4	0
B	**Medium**				
1	Milk cans (aluminium / steel) 10 lit	1.4 (9)	196	4.1	0
2	Milking Machine	NA	NA	NA	NA
3	Grass Cutter	1.9 (7)	106	2.7	0
4	Fodder Chaffer-Manual	NA	NA	NA	NA
5	Fodder Chaffer Power	NA	NA	NA	NA
6	Fodder Harvester/mowers	NA	NA	NA	NA
7	Feed Mixer	2 (8)	523	8.75	0
8	Grass Chopper	1.8 (7)	379	3	0
9	Fan, Fogger	NA	NA	NA	NA
10	Biogas unit	NA	NA	NA	NA
11	Tractor Trolly	NA	NA	NA	NA
12	Others (Feed Container)	4.1 (7)	773	4.4	0
C	**Large**				
1	Milk cans (aluminium / steel) 10 lit	2 (1)	171	3	0
2	Milking Machine	NA	NA	NA	NA
3	Grass Cutter	4 (1)	95	2	0
4	Fodder Chaffer-Manual	NA	NA	NA	NA
5	Fodder Chaffer Power	1 (1)	16765	10	0
6	Fodder Harvester/mowers	NA	NA	NA	NA
7	Feed Mixer	4(1)	857	3	0
8	Grass Chopper	NA	NA	NA	NA
9	Fan, Fogger	NA	NA	NA	NA
10	Biogas unit	1 (1)	60016	3	0
11	Tractor Trolly	NA	NA	NA	NA
12	Others (Feed Container)	20 (1)	167	3.5	0
D	**Overall**				
1	Milk cans (aluminium / steel) 10 lit	1.3 (240)	216	3.5	0
2	Milking Machine	NA	NA	NA	NA
3	Grass Cutter	2 (202)	119	2.7	0
4	Fodder Chaffer-Manual	NA	NA	NA	NA
5	Fodder Chaffer Power	1 (5)	18133	8	0
6	Fodder Harvester/mowers	NA	NA	NA	NA
7	Feed Mixer	1.3 (221)	470	4.5	0
8	Grass Chopper	1.1 (195)	332	6	0
9	Fan, Fogger	1.1 (29)	975	3.4	0
10	Biogas unit	1 (1)	60016	3	0
11	Tractor Trolly	1 (1)	2096	10	0
12	Others (Feed Container)	2.7 (190)	342	4	0
Source: Field Survey Data					

2.4 Source-wise Farmers' Income

Table 2.8: Source-wise Farmer's Households Gross Income (2020-21)

Sr. No	Particulars	Source-wise Farmer's Households Gross Average Income (2020-21) (Rs./household) (N=240)			
		Small	Medium	Large	Overall
1	Agriculture/Cultivation (1)	20391	76828	89000	23190
2	Agriculture Labour/ Wages (2)	26012	19000	NA	25827
3	Non-farm Labour	39585	29538	NA	39399
3	Animal farming (Sale of milk, Dung/FYM, Urine)	49052	148293	204000	53419
4	Animal farming- sale of animal	14658	19167	NA	15044
5	Non-Farm Employment- business/ Self Employment	75388	88500	NA	75918
6	Service (Job)	209667	60000	456000	214500
7	Any Other	171000	5000	NA	16902
	Gross Annual Income	149127.6	295240.7	749000	157106.3
Source: Field Survey Data					

The above Table 2.8 shows source-wise sample households' gross income in the financial year 2020-21. It is expected that earnings from a job or any service contribute more than any other income source. Income from agriculture and from the sale of milk, cow dung, and urine is increasing across milk-producing groups. Earnings from non-farm employment are also increasing relative to those from the farm category. Non-farm labour includes casual labour and MGNREGA work, and any other income includes toto driving and income from any other sources. Gross Annual Income is increasing over the farm categories.

Table 2.9: Correlation of Dairy Income and Total Income

Sr. No	Particulars	Correlation of Dairy Income and Total Income (N=240)			
		Small	Medium	Large	Overall
1	Pearson Correlation	0.4571	0.7924	-	0.5375
2	Significant (2 tailed)	0.0000***	0.0109**	-	0.0000***

NOTE: *** Correlation is significant at the 1% level (2-tailed)
** Correlation is significant at the 5% level (2-tailed)

As we mentioned in the methodology section, the Pearson correlation test is used to assess the relationship between dairy income and total income. It is found from the Table 2.9 that

for small producers, the correlation coefficient is significant at the 1% level, and for medium producers, it is significant at the 5% level, which is very obvious. For the overall sample, the correlation coefficient is significant at the 1% level, indicating that dairy income increases total annual income.

Table 2.10: Season-wise Milk Yield (Lit/day) and Milk Rate (Rs/lit) Realised by Selected Households

Sr. No	Particulars	Small				Medium				Large				Overall			
		Rainy	Winter	Summer	Av. Milk Rate (Rs./lit)	Rainy	Winter	Summer	Av. Milk Rate (Rs./lit)	Rainy	Winter	Summer	Av. Milk Rate (Rs./lit)	Rainy	Winter	Summer	Av. Milk Rate (Rs./lit)
1	Local cow	2.4	1.9	2.1	31	2.5	1.7	2.1	34	3.0	2.0	2.8	25	2.4	1.9	2.1	31
2	Cross Breed	5.9	5.0	5.2	33	7.1	5.9	6.7	36	-	-	-	-	6.0	5.0	5.3	34
3	Buffalo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Source: Field Survey Data																	

Table 2.10 shows that the average milk yield is highest in the rainy season, followed by summer and winter. It is very obvious that in rainy weather, cows eat more, as this is the harvesting time. But it is worth noting that the fat level becomes lower in this season. It is also found that the milk yield of cross-breed cows is nearly double that of local cows. Milk yields of both breeds are increasing across milk production categories. It is noticed that the Average milk rate is lower for the local cow.

2.5 Chapter Summary

i. In our sample, it is found that only one household out of the total sample is of large type, i.e. having more than four milch cows. It reveals that if we consider our sample as a representative one for West Bengal, above 95 percent of the sample dairy farmers are of the small holding category, showing either reluctance about cow rearing or do not consider this culture in a commercial manner.

ii. It is also observed that most of the sample households are headed by a male member, which is not very unusual in the case of rural Bengal. It is noted that all households in the medium and large categories are headed by male members.

Regarding the average education level of the household head, approximately half of the total sample falls at the secondary level, followed by the primary level and the illiterate category, respectively. Only one household with a Post-Graduate degree falls under the large milk producers' category. It is also found that the average household size for the overall sample is 5.1, higher than the state average. For medium milk producers, it becomes the highest, followed by small and large producers, respectively.

iii. It is found that the average number of family members engaged in dairy activity is almost half of the average household size for the overall sample, i.e. 2.5. It is also observed that in the case of religion, Hindu dominates significantly over all other religions, followed by Muslims for the overall sample, implying Hindus' usual religious tendency to rear cows and use domestic milk.

iv. It is observed in our sample that both the total number of animals and the total milch animals are higher for local cattle than for crossbreed. It is found that 71 households have their own funded pucca cattle sheds, while 2 households have borrowed funds and 4 have cattle sheds built with a subsidy received. In a nutshell, it is observed that the present value of any type of cattle shed is higher than the present value of fodder storage, and the average productive life is lower for a cattle shed than for fodder storage.

v. Holding of most of the milking assets like milking cans, grass cutter and chopper, and Feed container is increasing across milk producing categories, which is very usual. Earnings from a job or any service contribute more than any other income source. Income from agriculture and from the sale of milk, cow dung, and urine is increasing across milk-producing groups. Earnings from non-farm employment are also increasing relative to those from the farm category.

vi. It is also evident from Pearson's correlation test that dairy income pushes total annual income to increase. The average milk yield is highest during the rainy season, followed by summer and winter. It is very obvious that in rainy weather, cows eat more, as this is the harvesting time. The Milk yield of both breeds is increasing across milk-producing categories. It is noticed that the average milk rate is lower for local cow.

Chapter III

Cost of Milk Production & Sensitivity Analysis

3.1 Introduction

Cost is an integral part of the investment (input) in a production system that leads to the creation of more capital through output generation. The relationship between input costs and output revenues is critical for any manufacturing unit that requires policy intervention in future production decisions. In this section, the study focuses on describing the most important topic: the cost of milk production in West Bengal.

3.2 Details of Milch Animals

Cattle are the only major dairy animals, and buffalo are quite negligible in our sample for West Bengal. This study attempted to collect buffalo as milch animals for the study, but failed to find any in the study area. As a result, the study is limited to cows of various breeds as milch animals. For the purposes of the study and to facilitate estimation, the different breeds were split into two broad groups: local cattle (LC) and cross-breed cattle (CB).

The basic details of dairy animals and their various characteristics related to the dairy industry are depicted in Table 3.1. It is found that Local cattle (LC) have a lower estimated present market value than cross-bred cattle (CB) among small- and medium-scale milk producers. There is only one large farmer who rears only local cattle (LC). The average age and average age at first calving are both higher for the local cattle (LC) than the cross-breed cattle (CB) across the category of farming. The average lactation order is similar for both LC and CB cattle, at around 2.5. In the context of the milking cycle, the study found that the average dry and milk periods for LC milk are much longer than those for CB milk in our study area. The overall dry and milk periods for LC milk are approximately 245 and 263 days, respectively. It is also found that the average number of milk days is only about 7.35% higher than the dry period. The result is quite similar across the different sizes of dairy holdings in our covered sample.

Similarly, the dry and milk periods of CB milk are approximately 179 and 309 days, respectively. So it is also found that the average number of days of milk is about 72.62% higher than the dry period. Again, across different sizes of dairy holdings, the results are quite similar in our sample study area. The average milk drawn (two times a day) in milking time is

severely lower for the LC cattle (1.54 lit/day) than the CB cattle (4.34 lit/day), i.e. the average milk drawn (lit/day) of the CB cattle is about 181.82% higher than the LC cattle. The results are quite similar, regardless of the size of the dairy farmers in our West Bengal sample. West Bengal's milk production (litres per day) is generally lower than that of other states those are developed in dairy farming in India.

Table 3.1: Details of Milch Animals (Dry + In Milk) on Survey Date

Sr. No.	Group	Animal & Type	Details of Milch Animals							
			Estimated Present Market value (Rs./ animal)	Av. Age of Animal (Years)	Av. Age at first calving (months)	Present No. of Lactation Order (Av.)	Dry Period (days)	In Milk (days)	Av. Milk Drawn (lit/day) two times- when 'IN MILK'	Milk Drawn (lit/day) two times (for whole CYCLE)
1	Small	LC	12948.63	6.76	50.24	2.44	242.87	265.32	1.52	403.29
		CB	25322.22	6.23	39.93	2.70	180.71	308.23	4.34	1337.72
		B	-	-	-	-	-	-	-	-
2	Medium	LC	13125	7.28	52.56	2.81	233.13	237.5	1.86	441.75
		CB	31071.43	5.86	35.86	2.50	161.54	318.46	4.36	1388.49
		B	-	-	-	-	-	-	-	-
3	Large	LC	9444.44	7.22	52.78	2.44	300	273.33	1.57	429.13
		CB	-	-	-	-	-	-	-	-
		B	-	-	-	-	-	-	-	-
4	Overall	LC	12780.70	6.83	50.59	2.68	245.43	263.14	1.54	405.24
		CB	25862.42	6.20	39.54	2.47	178.76	309.14	4.34	1341.67
		B	-	-	-	-	-	-	-	-
Source: Field Survey Data										

3.3 Cost of Feed and Fodder

Feed and fodder account for the largest share of total input costs in dairy farming, at least in our sample. Dry and green fodder are the main components of feed and fodder in West Bengal. Concentrates and supplements are also provided to the cattle, but the amounts are very low compared to those given in more advanced dairy-farming states. Here, the important locational sources for collecting or grazing animals are green fodder, uncultivated and fallow land, and grass from weeding in agriculture. So far, no costs have been observed for green fodder in the state of West Bengal. On the other hand, it is observed in the study that the dry fodder comprises mainly two types of fodder: hay (paddy straw), a by-product of paddy, and oilcake, a by-product of mustard, which is mainly purchased from markets in the study area. Cereals primarily consist of rice, rice husk, and wheat, which are grown in-house and purchased from local markets. Calcium, vitamins, and various types of substitutes are available as fodder supplements, mostly bought at local markets. In general, the supply of

major feed and fodder is closely linked to agricultural production and activities. So the consumption may also be dependent on the seasons of cultivation. Hence, the study is trying to find out the seasonal consumption pattern of feed and fodder for the state of West Bengal. The study also tried to compare the consumption variation of feed and fodder between the milk period and the dry period for the state of West Bengal.

Table 3.2: Fodder Consumption as per Winter Seasons (kg / day)

Sr. No.	Particulars	Feed Cost - Market Rate (Rs./kg)	Fodder(kg/day) -In milk period			Fodder (kg/day) - Dry period		
	DCS-Summer		Local Cattle	Cross Breed	Buffalo	Local Cattle	Cross Breed	Buffalo
a	**Small**							
1	Green-Fodder	0.00	2.15	4.55	-	2.15	4.54	-
2	Dry Fodder	5.31	7.79	7.59	-	7.69	7.49	-
3	Concentrates	15.85	1.08	1.52	-	0.78	1.25	-
4	Supplements	190.04	0.02	0.08	-	0.00	0.01	-
5	Others	23.15	0.01	0.02	-	0.01	0.01	-
b	**Medium**							
1	Green-Fodder	0.00	0.00	1.50	-	0.00	1.50	-
2	Dry Fodder	2.45	7.09	6.96	-	7.09	6.96	-
3	Concentrates	16.14	0.85	1.61	-	0.60	1.38	-
4	Supplements	221.91	0.04	0.04	-	0.00	0.01	-
5	Others	8.50	0.03	0.04	-	0.03	0.04	-
c	**Large**							
1	Green-Fodder	0.00	0.00	-	-	0.00	-	-
2	Dry Fodder	1.64	7.04	-	-	7.04	-	-
3	Concentrates	10.77	0.92	-	-	0.92	-	-
4	Supplements		0.00	-	-	0.00	-	-
5	Others	40.00	0.07	-	-	0.07	-	-
d	**Overall**							
1	Green-Fodder	0.00	2.03	4.38	-	2.03	4.37	-
2	Dry Fodder	5.19	7.75	7.55	-	7.66	7.46	-
3	Concentrates	15.84	1.06	1.52	-	0.77	1.26	-
4	Supplements	191.73	0.02	0.07	-	0.00	0.01	-
5	Others	21.81	0.01	0.02	-	0.01	0.01	-
Source: Field Survey Data								

Table 3.2 above shows the details of feed and fodder consumed by the cattle during both the milking and dry periods of the winter season. The table shows that there is no significant difference in feed and fodder consumption between the milk and dry periods for green and

dry fodder across milk producer sizes. In the case of concentrates and supplements, consumption is slightly higher during the milk period than during the dry periods in winter in West Bengal. The table also lists the market prices of feed and fodder during the winter season. The study found that green fodder was cost-free in the study area for the state of West Bengal across all sizes of milk producers. The study also found a significant change in the average price of dry fodder across milk producer sizes during the winter season. According to the study, the average cost per kg of dry fodder is highest for small milk producers and decreases as milk producer size increases.

Tables 3.3 and 3.4 show the details for the rainy and summer seasons, respectively. The variation in consumption of feed and fodder between the milk and dry periods is also similar to that during the winter season in the sample study area of West Bengal. In a season-wise comparison, it is found that consumption of green fodder is significantly higher in the rainy season than in the winter. This is due to the freely available green fodder during the rainy seasons. The increase in consumption of green fodder leads to a decrease in the consumption of dry fodder in rainy seasons compared to winter seasons.

Table 3.3: Fodder Consumption as per Rainy Seasons (kg/day)

Sr. No.	Particulars	Feed Cost - Market Rate (Rs./kg)	Fodder(kg/day) -In milk period			Fodder (kg/day) - Dry period		
	DCS-Summer		Local Cattle	Cross Breed	Buffalo	Local Cattle	Cross Breed	Buffalo
a	**Small**							
1	Green-Fodder	0.00	9.06	7.30	-	9.03	7.40	-
2	Dry Fodder	5.74	6.71	6.81	-	6.60	6.72	-
3	Concentrates	16.01	1.06	1.49	-	0.77	1.12	-
4	Supplements	190.04	0.02	0.08	-	0.00	0.01	-
5	Others	23.15	0.01	0.02	-	0.01	0.01	-
b	**Medium**							
1	Green-Fodder	0.00	3.28	3.07	-	2.75	2.67	-
2	Dry Fodder	2.46	6.46	6.50	-	6.45	6.50	-
3	Concentrates	16.14	0.85	1.61	-	0.60	1.38	-
4	Supplements	221.91	0.04	0.04	-	0.00	0.01	-
5	Others	8.50	0.03	0.04	-	0.03	0.04	-
c	**Large**							
1	Green-Fodder	0.00	0.00	-	-	0.00	-	-
2	Dry Fodder	1.64	7.04	-	-	7.04	-	-
3	Concentrates	10.77	0.92	-	-	0.92	-	-
4	Supplements		0.00	-	-	0.00	-	-
5	Others	40.00	0.07	-	-	0.07	-	-
d	**overall**							
1	Green-Fodder	0.00	8.72	7.07	-	8.66	7.13	-
2	Dry Fodder	5.60	6.70	6.79	-	6.60	6.71	-
3	Concentrates	16.00	1.05	1.50	-	0.76	1.14	-
4	Supplements	191.73	0.02	0.07	-	0.00	0.01	-
5	Others	21.81	0.01	0.02	-	0.01	0.01	-

Source: Field Survey Data

Table 3.4: Fodder Consumption as per Summer Seasons (kg / day)

Sr. No.	Particulars	Feed Cost - Market Rate (Rs./kg)	Fodder(kg/day) -In milk period			Fodder (kg/day) - Dry period		
	DCS-Summer		Local Cattle	Cross Breed	Buffalo	Local Cattle	Cross Breed	Buffalo
a	**Small**							
1	Green-Fodder	0.00	3.77	5.66	-	3.78	5.79	-
2	Dry Fodder	5.51	7.15	7.19	-	7.03	7.09	-
3	Concentrates	15.85	1.06	1.49	-	0.77	1.12	-
4	Supplements	191.26	0.02	0.07	-	0.00	0.01	-
5	Others	23.15	0.01	0.02	-	0.01	0.01	-
b	**Medium**							
1	Green-Fodder	0.00	0.37	1.84	-	0.37	1.84	-
2	Dry Fodder	2.55	6.87	6.53	-	6.87	6.53	-
3	Concentrates	16.14	0.85	1.61	-	0.60	1.38	-
4	Supplements	221.91	0.04	0.04	-	0.00	0.01	-
5	Others	16.80	0.03	0.05	-	0.03	0.05	-
c	**Large**							
1	Green-Fodder	0.00	0.00	-	-	0.00	-	-
2	Dry Fodder	1.64	7.04	-	-	7.04	-	-
3	Concentrates	10.77	0.92	-	-	0.92	-	-
4	Supplements		0.00	-	-	0.00	-	-
5	Others	40.00	0.07	-	-	0.07	-	-
d	**overall**							
1	Green-Fodder	0.00	3.58	5.45	-	3.59	5.57	-
2	Dry Fodder	5.38	7.13	7.15	-	7.03	7.06	-
3	Concentrates	15.84	1.05	1.49	-	0.76	1.14	-
4	Supplements	192.89	0.02	0.07	-	0.00	0.01	-
5	Others	22.69	0.01	0.02	-	0.01	0.01	-

Source: Field Survey Data

Along with feed and fodder costs, grazing costs are another important component of cattle cultivation costs. Respondents in the sample area reported that no cost is incurred for grazing; i.e., the grazing cost is reported as zero for the West Bengal sample area. This is also shown in Table 3.5, where the grazing costs are zero. According to the table, the average grazing hours are highest in the summer and lowest during the rainy season. This is because the cultivable lands are the main sources of grazing land for cattle during the lean season.

Table 3.5: Average Grazing Time and Cost per Milch Animal

Sr. No.	Particulars	Winter		Rainy		Summer	
		Average Grazing hours /day	Grazing cost/ month	Average Grazing hours /day	Grazing cost/ month	Average Grazing hours /day	Grazing cost/ month
a	**Small**						
1	LC	2.09	0	0.40	0	3.78	0
2	CB	0.56	0	0.19	0	1.94	0
3	B	-	-	-	-	-	-
b	**Medium**						
1	LC	0.96	0	0	0	2.90	0
2	CB	1.18	0	0	0	3.56	0
3	B	-	-	-	-	-	-
c	**Large**						
1	LC	0	0	3	0	0	0
2	CB	-	-	-	-	-	-
3	B	-	-	-	-	-	-
d	**All**						
1	LC	2.02	0	0.39	0	3.71	0
2	CB	0.61	0	0.18	0	2.05	0
3	B	-	-	-	-	-	-
Source: Field Survey Data							

3.4 Labour Use and Other Expenditure

In the calculation of the cost of milk production in dairy activities, the labour use and its cost is very important components to deal with. In West Bengal, family labour is the primary source of labour supply in dairy activities, while the use of hired labour is very minor. The imputed cost of family labour has been calculated for the estimation of the cost of cultivation. The imputed value of family labour has been calculated here as the valuation of family labour hours given in dairy activities multiplied by the standard market labour rate for both male and female labour in the locality.

In Table 3.6, the average cost (Rs. per day per milk animal) is about Rs. 66 (including male and female labour), and almost 99.7% of the total labour cost is contributed by family labour. The result emphasises that labour costs are calculated as part of the total cost of milk production, but in physical terms, they have not incurred such a cost, as they supply it themselves. In the following table, it is found that the marginal labour cost per cattle decreases as cattle size increases in our sample area. The findings support the following table: small milk producers have the highest labour cost (Rs. per day per milk animal), while large milk producers have the lowest. It should be noted that nearly 96 per cent of total milk

producers in our sample are small in size; thus, the overall labour cost is mainly determined by the cost of the small category of milk producers.

Table 3.6: Labour Use for Dairy Activities by Selected Households (Rs./day/milch animal)

Sr. No	Particulars	Family Human Labour		Hired Human Labour	
		Male	Female	Male	Female
a	Small	30.45	36.46	0.22	0.00
b	Medium	15.86	18.17	0.00	0.00
c	Large	20.83	0.00	0.00	0.00
d	overall	29.87	35.62	0.21	0.00
Source: Field Survey Data				Note: Average without weight.	

Table 3.7 presents the other expenditures producers incur for milk. The table shows that average veterinary and Artificial Insemination (AI) cost is Rs. 2.27/- per day and Rs. 244 per year per cattle respectively. The study has found no transportation cost and a tiny amount of light and water cost in the sample area of West Bengal. The study also found that the average cost of maintenance, repair of cattle shed and equipment is Rs. 2.10/- per day per milch cattle.

Table 3.7: Other Expenditures Incurred by Selected Households

Sr. No	Particulars	Other Expenditures (Rs./ day/milch animal)				
		Veterinary Cost plus vaccination, deworming, etc	AI Cost Rs / Year	Transport Cost	Repair/ Maintenance Cost of equipment/ Home	Light & Water Charges
a	Small	2.26	244.55	0.00	2.16	0.25
b	Medium	2.54	255.55	0.00	0.55	0.07
C	Large	0.91	200.00	0.00	1.52	0.15
C	overall	2.27	244.78	0.00	2.10	0.24
Source: Field Survey Data					Note: Average without weight.	

3.5 Sale of Milk and Other Income

It is found that, among the total milk produced by local cows, most is self-consumed, followed by sale to NDCS or private agents for small and medium holders and the overall sample. The only large farmer is consumed less than that of sold. In case of cross breed sale to agent is highest followed by sold to consumers or hotel for the overall sample. For the small producers the story is opposite and similar for medium producers. Other product of milk is found only in hilly region, so the rate of raw milk in Kalimpong is considered here. For the other product, cross breed milk is used more. So, in a nutshell it is clear from our

sample that local cows are generally reared for domestic consumption of milk and cross breeds are mainly for commercial purpose.

Table 3.8 shows details on milk sales by selected households.

Table 3.8: Details on Sale of Milk by Selected Households

Particulars		Milk HH Use/ day (% of total)	Sale of Milk							
			DCS		NDCS/ Agent		Consumer, Hotel, etc.		Used as Other Product	
			Qty (% of total)	Rate Rs/Lit	Qty (% of total)	Rate Rs/Lit	Qty (% of total)	Rate Rs/Lit	Qty (% of total)	Rate Rs/Lit*
DCS										
Small	LC	83.9 (49.3)	11 (6.5)	27.4	43.75 (25.8)	27.2	26.2 (15.4)	35.3	5 (3)	47
	CB	96.9 (23.3)	12 (2.9)	27.25	114.95 (27.6)	29.6	124.75 (29.9)	37	68 (16.3)	42
	B	-	-	-	-	-	-	-	-	-
Medium	LC	7.5 (57.7)	0 (0)	0 (0)	3.5 (26.9)	25	2 (15.4)	37.5	0 (0)	0
	CB	7.5 (15.7)	7.5 (15.6)	26	27 (56.3)	37	6 (12.5)	38.75	0 (0)	0
	B	-	-	-	-	-	-	-	-	-
Large	LC	2 (18.2)	0 (0)	0 (0)	9 (81.8)	25	0 (0)	0	0 (0)	0
	CB	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-
Overall	LC	93.4 (48.2)	11 (5.7)	27.4	56.25 (29)	27	28.2 (14.5)	35.4	5 (2.6)	47
	CB	104.4 (22.5)	19.5 (4.2)	27	141.95 (30.6)	30	130.75 (28.1)	37.2	68 (14.6)	42
	B	-	-	-	-	-	-	-	-	-
Source: Field Survey Data										

3.6 Cost of Milk Production

In calculating the cost of milk production in West Bengal, the standard methodology has been applied. All fixed and variable costs have been taken into account in the calculation of the cost of milk production. The structure of the components of the total cost of milk production, along with other important aspects related to milk production costs, is depicted in Table 3.9. The study also examines results across cattle breeds and milk producer sizes.

The following table shows that the overall cost per day for cross-breed milch is higher than for local milch, and the same holds for small- and medium-sized milk producers. For the large milk producer, the sample includes only local cattle. The per-day milk cost is significantly lower for medium- and large-scale milk producers than for small-scale producers. One of the main reasons for the lower cost of milk production among medium and large milk producers is lower fodder and labour costs than among small milk producers. The lower fodder cost is due to a significantly lower dry fodder rate for medium and large milk producers. On the other hand, to calculate the labour cost for milk producers, the total labour cost has been divided by the number of milch animals. In this study, we found that home labourers are mostly employed in dairy activities, and they work for a certain amount of time in dairy activities alongside their main occupation in other activities. Henceforth with a large number of milch cattle, the labour employed in dairy does not increase proportionally, leading to a drastic fall in labour cost per milch cattle for the medium and large milk producers. The perspective of marginal cost also supported that as cattle size increases, the marginal cost per day per milch should be decreased, and it is found for both local and cross-breed milch of medium and large milk producers. But the milk producers in the state of West Bengal are not benefitted from this marginal cost perspective as most of them are small (almost 96%) milk producers.

The variable cost is the major component that is contributing to the total cost, and the share is more than 95 percent across all the milk producers. Among the total variable costs, labour and fodder are the main components, accounting for over 95 per cent. The ratio of feed cost to total variable cost is quite the same across the breeds, but the ratio is higher for medium and large milk producers than for the small milk producers.

Further, the study estimated the gross income of the milk producers, showing it in table 3.9. From the table, it is found that the earnings from the overall average earnings from cross-breed cattle are more than 2.5 times higher than the earnings from local milch cattle. In comparison between different sizes of milk producers, it is found that there is a positive relation between gross income and the size of milk producers across the breed of the milch animal.

The net income is calculated by deducting the cost of milk production from the total gross income of the milk producers. From the table, it is found that per-day net income is severely

low from local cattle over the cost of cultivation for milk producers of all sizes. For the small milk producers, the net income per day per local cattle is Rs. -54.37 over the cost of cultivation; it is Rs. 10.24 and Rs. 26.88 for medium and large milk producers, respectively. The net income per crossbred cow per day is Rs. 28.30 for small milk producers, and it is Rs. 145.85 for medium milk producers. The average overall net income per day per local milch is found to be Rs. 50.99, and it is Rs. 39.30 for cross-breed cattle. One of the main reasons for the critically low net income from local cattle is the low yield of milk per day and a very lower of market price of raw milk in the study area. The income from cross breed cattle is quiet high than the local cattle but still it is not adequate income earning from their rearing compared to other major milk producing states. Though average yield of milk of cross breed cattle is near about double than local cattle, hence the income per cross breed cattle per day pretty high. But the lower selling price of milk creates an obstacle towards income generation of milk producers. Hence the net income from cross breed also very low. Here the study has calculated the average ratio of variable cost to sale price of milk across the breed and size of milk producers. Here it is to be noted that the lowers the value of ratio indicates the good picture in the dairy activities. From the table 3.9., it is found that the average value of ratio is highest for the small milk producers in the state West Bengal.

In the process of analysis, the cost of milk per litre is also calculated and it is found that the overall average per litre cost of milk of the local cattle is about Rs. 56.43, where it is Rs. 27.46 for the cross-breed cattle. Across the size of milk producers, the result is the same for the small milk producers, but for the medium milk producers, the cost per litre of local cattle milk is more than double that of the cross-breed milch. The main reason behind such a result is the difference in the yield rate between local and crossbred cattle. The yield of crossbred cattle is more than double that of local cattle for small milk producers.

For the medium milk producers, the cost of milk per litre is lower than that of the small milk producers for both the local and cross-breed cattle. But among breeds, the cost difference is similar among small milk producers: the cost of milk per litre from local cattle is almost double that from cross-breed cattle. Another notable feature is that the ratio of milk selling price to fodder cost is significantly lower for our sample in West Bengal. Though the ratio is more than double for cross-breed cattle compared to local cattle, and the result is quite the same across the size of milk producers.

Table 3.9: Cost of Milk Production (per day per milch animal) in Selected Households

Sr. No	Particulars	Small			Medium			Large			All		
		Cattle		Buffalo	Cattle		Buffalo	Cattle			Cattle		Buffalo
		Local	Cross Breed		Local	Cross Breed		Local	Cross Breed	Buffalo	Local	Cross Breed	
A	Fodder	56.35	69.31	-	33.24	46.12	-	24.37	-	-	55.27	68.22	-
	Labour	60.30	73.17	-	26.72	39.07	-	20.83	-	-	58.25	70.97	-
	Vet. Cost	1.64	2.85	-	1.80	3.05	-	0.91	-	-	1.64	2.86	-
	Other	2.75	3.31	-	1.26	1.44	-	2.22	-	-	2.66	3.19	-
	Variable Cost	121.03	148.63	-	63.03	89.67	-	48.34	-	-	117.83	145.23	-
B	Fixed Cost	2.68	3.94	-	0.94	4.19	-	1.47	-	-	2.55	3.95	-
C	Total Cost	123.72	152.58	-	63.97	93.87	-	49.81	-	-	120.38	149.18	-
D	Revenue												
	Sale of Milk	66.13	177.10	-	71.40	236.40	-	65.00	-	-	66.13	184.73	-
	Other Income	3.22	3.77	-	2.81	3.31	-	11.69	-	-	3.25	3.75	-
E	Total Income	69.35	180.87	-	74.21	239.71	-	76.69	-	-	69.39	188.48	-
F	Net Income (Total income – Total cost)	-54.37	28.30	-	10.24	145.85	-	26.88	-	-	-50.99	39.30	-
G	Cost of milk(Rs./litre)	57.99	28.43	-	30.46	14.29	-	19.16	-	-	56.43	27.46	-
H	Milk Yield (litre/animal/day)	2.13	5.37	-	2.10	6.57	-	2.60	-	-	2.13	5.43	-
I	Per litre Cost of Fodder (Rs./lit)	26.41	12.92	-	15.83	7.02	-	9.37	-	-	25.91	12.56	-
J	Ratio (Milk Sale Price to Fodder Cost/litre)	1.17	2.56	-	2.15	5.13	-	2.67	-	-	1.20	2.71	-
K	Feed Cost to Total Variable Cost (%)	46.56	46.63	-	52.75	51.43	-	50.42	-	-	46.91	46.97	-
L	Ratio of Variable Cost to Sell Price	3.90	4.50	-	1.85	2.49	-	1.93	-	-	3.80	4.27	-
Source: Authors' Calculation from Field Survey Data													

3.7 Sensitivity Analysis

A Sensitivity Analysis is the method that indicates the impact of the dependent variable on the variation of the independent variables. This is one type of control treatment method for

determining the responses of the control or dependent variable to the variation or treatment of the independent variable. In the policy management sector, the Sensitivity Analysis is very popular, as the results can predict the appropriate policy for decision-making among the best alternatives. The analysis can also be referred to as the 'Simulation', i.e., a system that proposes an alternative approach to an existing system by testing the different scenarios among the alternatives for critical decision-making.

Sensitivity Analysis in the dairy activities can also be very impactful for the sustainable growth of the sector. With this 'Simulation' approach, the policy expert can find answers to critical policy questions about the cost and income management mechanism. The present study also employed a sensitivity analysis to examine the responses of net income to variations in input costs and milk yield rates. More specifically, the study tries to estimate the total cost of milk production by using the following scenarios:

Scenario I: Decrease in fodder cost by 5% & increase in milk yield by 5%.
Scenario II: Only a decrease in fodder cost by 5%.
Scenario III: Only an increase in milk yield by 5%.

The theme of the Sensitivity Analysis in this study is to determine the most relevant action to enhance dairy farmers' income. Here, the study sought to identify the optimal path between cost reduction and increased milk yield to increase the net income of dairy farmers. In general, both increasing the yield rate and reducing costs are optimal policies to boost the net income of milk producers, but due to insufficient funds for policy management, it is not possible to implement such policies. In these circumstances, if only one policy can be selected, Sensitivity Analysis helps determine the best policy among the alternatives.

In this study, three scenarios have been considered: in Scenario I, both cost-cutting and yield increase have been used to examine responses in net income. To determine the best way out of these two, Scenario II has been chosen, in which the income response is achieved by reducing the fodder cost by 5 per cent. In scenario III, the income response is based solely on increasing the yield rate by 5 per cent. The results of the Sensitivity Analysis are tabulated in the following tables: 3.10, 3.11, and 3.12.

Table 3.10: Sensitivity Analysis for Changes in Fodder Cost (reduction by 5%) & Milk Yield (increase by 5%)

Sr. No	Particulars	Cost of Milk Production (Rs. per day per animal) Assumption of reduction in fodder cost (by 5%) and increase in milk yield (by 5%)											
		Small			Medium			Large			Overall		
		L	CB	B	L	CB	B	L	CB	B	L	CB	B
A	Variable Cost												
	Fodder	53.53	65.85	-	31.58	43.81	-	23.16	-	-	52.51	64.81	-
	Labour	60.30	73.17	-	26.72	39.07	-	20.83	-	-	58.25	70.97	-
	Vet. Cost	1.64	2.85	-	1.80	3.05	-	0.91	-	-	1.64	2.86	-
	Other	2.75	3.31	-	1.26	1.44	-	2.22	-	-	2.66	3.19	-
	Total	118.22	145.17	-	61.37	87.37	-	47.12	-	-	115.06	141.82	-
B	Fixed Cost	2.68	3.94	-	0.94	4.19	-	1.47	-	-	2.55	3.95	-
C	Total Cost	120.90	149.11	-	62.31	91.56	-	48.59	-	-	117.62	145.77	-
D	Revenue												
	Milk Yield	2.24	5.64	-	2.21	6.90	-	2.73	-	-	2.24	5.71	-
	Rate of Milk (Rs./litre)	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
	Sale of Milk	69.44	185.96	-	74.97	248.22	-	68.25	-	-	69.44	193.97	-
	Other Income	3.22	3.77	-	2.81	3.31	-	11.69	-	-	3.25	3.75	-
E	Total Income	72.66	189.73	-	77.78	251.53	-	79.94	-	-	72.69	197.72	-
F	Net Income*	- 48.24	40.62	-	15.47	159.97	-	31.35	-	-	- 44.92	51.95	-
H	Cost Per lit. milk (Rs.)	53.97	26.46	-	28.26	13.28	-	17.80	-	-	52.51	25.55	-
I	Net Income Increase By Rs. (%)	6.13 (11.26)	12.32 (43.54)	-	5.23 (51.12)	14.12 (9.69)	-	4.47 (16.62)	-	-	6.07 (11.90)	12.65 (32.18)	-
Source: Authors' Calculation from Field Survey Data; *Net Income = Total income –Total cost													

The above table 3.10 shows the Sensitivity Analysis with Scenario I, where the study assesses the impact of net income by reducing the cost by 5 per cent from the actual total cost and increasing the yield rate by 5 percent from the actual yield, keeping the other factors constant. Changes in fodder costs and milk yields directly affect the existing variable costs and gross income. As a result, it is found that overall income from local cattle increased by 11.90 percent, and it is 32.18 per cent from cross-breed cattle. Across milk producer sizes, it is found that for small milk producers, the percentage increase in net income is highest for net income from cross-breed cattle, whereas the result is inverse for medium milk producers. In an absolute sense, overall income increases by Rs. 6.07 for local cattle and by Rs. 12.65 for cross-breed cattle. Across milk producer sizes, the increase in net income is highest for cross-breed cattle of medium milk producers, and the increment is lowest for local cattle of large milk producers.

If the assumption changes to a reduction in fodder cost only, as mentioned in Scenario II, the result differs from the previous scenario, as shown in Table 3.11. Here, the assumption has been taken into account to reduce fodder costs by 5 per cent, and the impact on net income has been assessed. The change in fodder cost will affect variable costs but will not affect revenue. From the table, it is found that overall income from local cattle increases by Rs. 2.76 (5.42%), and income from cross-breed cattle increases by Rs. 3.41 (8.68%). Across the size of milk producers, the percentage increase in net income is highest from cross-breed cattle for small milk producers, and it is highest from local cattle for medium-sized milk producers. Across the size of milk producers, it is found that the increase in net absolute income is highest for small milk producers than medium and large milk producers.

Table 3.11: Sensitivity Analysis for Changes in Fodder Cost (reduction by 5%) in Selected Households

Sr. No	Particulars	Cost of Milk Production (Rs. per day per animal) **Assumption of reduction in fodder cost (by 5%)**											
		Small			Medium			Large			Overall		
		L	CB	B	L	CB	B	L	CB	B	L	CB	B
A	Variable Cost												
	Fodder	53.53	65.85	-	31.58	43.81		23.16	-	-	52.51	64.81	-
	Labour	60.30	73.17	-	26.72	39.07		20.83	-	-	58.25	70.97	-
	Vet. Cost	1.64	2.85	-	1.80	3.05		0.91	-	-	1.64	2.86	-
	Other	2.75	3.31	-	1.26	1.44		2.22	-	-	2.66	3.19	-
	Total	118.22	145.17	-	61.37	87.37		47.12	-	-	115.06	141.82	-
B	Fixed Cost	2.68	3.94	-	0.94	4.19		1.47	-	-	2.55	3.95	-
C	Total Cost	120.90	149.11	-	62.31	91.56		48.59	-	-	117.62	145.77	-
D	Revenue												
	Milk Yield	2.13	5.37	-	2.10	6.57		2.60	-	-	2.13	5.43	-
	Rate of Milk (Rs./litre)	31.00	33.00	-	34.00	36.00		25.00	-	-	31.00	34.00	-
	Sale of Milk	66.13	177.10	-	71.40	236.40		65.00	-	-	66.13	184.73	-
	Other Income	3.22	3.77	-	2.81	3.31		11.69	-	-	3.25	3.75	-
E	Total Income	69.35	180.87	-	74.21	239.71		76.69	-	-	69.39	188.48	-
F	Net Income*	-51.55	31.76	-	11.90	148.15		28.10	-	-	-48.23	42.71	-
H	Cost Per Lit milk (Rs)	56.67	27.78	-	29.67	13.94		18.69	-	-	55.13	26.83	-
I	Net Income Increase By Rs. (%)	2.82 (5.18)	3.46 (12.25)	-	1.66 (16.24)	2.30 (1.58)		1.22 (4.53)	-	-	2.76 (5.42)	3.41 (8.68)	-
Source: Authors' Calculation from Field Survey Data; *Net Income = Total income –Total cost													

The study has made another assumption about changes in milk yield (as mentioned in Scenario III) and has assessed the impact on net income. The result of this assumption is

shown in Table 3.12. In this case the structure of cost remains same but income changes due to the change of the revenue of the milk producers. From the table it is found that over all income from local cattle increases by 6.48 percent and it is 23.50 percent from cross breed cattle. Across the size of milk producers, percentage increase in net income is highest from cross breed cattle for small milk producers and it is highest from local cattle for medium size of milk producers. In absolute sense, over all income increases almost Rs. 3.30 for local cattle and it is almost Rs. 9.24 for cross breed cattle. Across the size of milk producers, it is found that the increase in net absolute income is highest for medium milk producers than small and large milk producers.

Table 3.12: Sensitivity Analysis for Changes in Milk Yield (increase by 5%)

Sr. No	Particulars	Cost of Milk Production (Rs. per day per animal) **Assumption of increase in milk yield (by 5%)**											
		Small			Medium			Large			Overall		
		L	CB	B	L	CB	B	L	CB	B	L	CB	B
A	Variable Cost												
	Fodder	56.35	69.31	-	33.24	46.12	-	24.37	-	-	55.27	68.22	-
	Labour	60.30	73.17	-	26.72	39.07	-	20.83	-	-	58.25	70.97	-
	Vet. Cost	1.64	2.85	-	1.80	3.05	-	0.91	-	-	1.64	2.86	-
	Other	2.75	3.31	-	1.26	1.44	-	2.22	-	-	2.66	3.19	-
	Total	121.03	148.63	-	63.03	89.67	-	48.34	-	-	117.83	145.23	-
B	Fixed Cost	2.68	3.94	-	0.94	4.19	-	1.47	-	-	2.55	3.95	-
C	Total Cost	123.72	152.58	-	63.97	93.87	-	49.81	-	-	120.38	149.18	-
D	Revenue												
	Milk Yield	2.24	5.64	-	2.21	6.90	-	2.73	-	-	2.24	5.71	-
	Rate of Milk (Rs./litre)	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
	Sale of Milk	69.44	185.96	-	74.97	248.22	-	68.25	-	-	69.44	193.97	-
	Other Income	3.22	3.77	-	2.81	3.31	-	11.69	-	-	3.25	3.75	-
E	Total Income	72.66	189.73	-	77.78	251.53	-	79.94	-	-	72.69	197.72	-
F	Net Income*	-51.06	37.15	-	13.81	157.67	-	30.13	-	-	-47.69	48.54	-
H	Cost Per Lit milk (Rs)	55.23	27.08	-	29.01	13.61	-	18.25	-	-	53.74	26.15	-
I	Net Income Increase By Rs. (%)	3.31 (6.08)	8.85 (31.30)	-	3.57 (34.88)	11.82 (8.10)	-	3.25 (12.09)	-	-	3.30 (6.48)	9.24 (23.50)	-
Source: Authors' Calculation from Field Survey Data; *Net Income = Total income –Total cost													

Concluding from the results of Sensitivity Analysis, it is evident that with the help of the 'Simulation' or 'Sensitivity Analysis' approach, the study has tried to establish a possible policy way out to ensure sustainable growth and development of the dairy business. The main objective of the described 'simulation' approach is to identify the best policy option among

the alternatives for the development of the dairy business. In the dairy business or activities, the broad approach to sector development is mainly two types: cost reduction and increased revenue through higher milk yield from milch animals. Here, both approaches have been estimated, and their impact on income has been examined and described in the three tables above. No doubt that both approaches (cost reduction and increase in the yield rate of milch animals) can jointly increase net income to a level that cannot be reached with either approach alone. This is also shown in the three tables above. The percentage change in net income is greatest when both approaches are taken jointly. However, comparing these two approaches, the study found that the 5 percent increase in yield is more dominant than the 5 percent increase in income from reduced fodder costs, as shown in Tables 3.11 and 3.12. Hence, in general, the policy relating to an increase in yield is found to be more impactful in determining the net income of milk producers than the decrease in fodder cost, but policy management should also consider the cost component to suggest a policy between the above two approaches.

3.8 Chapter Summary

i. Cattle are the only major dairy animals, and buffalo are quite negligible in our sample, at least in the state of West Bengal. To serve the study's purpose by making it easier to estimate several measures, the different breeds were split into two broad groups: local cattle (LC) and cross-breed cattle (CB).

ii. Local cattle (LC) have a lower estimated present market value than cross-breed cattle (CB) among small and medium milk producers. The average age and average age at first calving are both higher for the local cattle (LC) than the cross-breed cattle (CB) across the milk-producing categories. The average lactation order is similar for both LC and CB cattle, at around 2.5.

iii. In the case of the milking cycle, the study has found that the average dry and in milk period for LC in milk is much higher than that for CB in milk in our study area. The overall dry and in milk periods of LC milk are near 245 days and 263 days, respectively, and it is approximately 179 and 309 days for CB.

iv. The average milk drawn (two times a day) in milking time is severely lower for the LC cattle (1.54 lit/day) than the CB cattle (4.34 lit/day), and the average milk drawn

(lit/day) of the CB cattle is about 181.82% higher than the LC cattle. The results are quite similar across the sizes of dairy farmers in our West Bengal sample.

v. There is no significant difference in feed and fodder consumption in quantity between the milk and dry periods for both green and dry fodder across the size of milk producers, but it varies across different seasons. The consumption of green fodder is significantly higher in the rainy season than in the winter. This is due to the free availability green fodder during the rainy seasons. An increase in the consumption of green fodder leads to a decrease in the consumption of dry fodder in rainy seasons compared to winter seasons.

vi. The study discovered a significant change in the average price of dry fodder across the size of milk producers and seasons. According to the study, the average cost per kg of dry fodder is highest for small milk producers and decreases as milk producer size increases.

vii. The respondents of the sample area have reported that there is no cost incurred for the grazing; hence, the grazing cost is reported as zero for the sample area of West Bengal.

viii. It is found that the average cost of labour (Rs. per day per milch animal) is about Rs. 66, and almost 99.7% of the total labour cost is contributed by family labour. The result emphasises that labour costs are calculated as part of the total cost of milk production, but in physical terms, they have not incurred such a cost, as they supply it themselves. Also, the marginal labour cost per cattle decreases as the size of cattle increases in our sample study area.

ix. The average veterinary cost is Rs. 2.27/- per day per milch animal, and Artificial Insemination (AI) cost is Rs. 244 per year per cattle, respectively. The study has found no transportation costs and a tiny amount of light and water costs in the sample area of West Bengal.

x. It is found that out of the total milk given by local cows, most of the milk is self-consumed, followed by sold to NDCS or private agents in the case of small and medium holders and the overall sample. In the case of cross-breed sales to an agent is the highest, followed by sales to consumers or hotels for the overall sample. For

small producers, the story is the opposite of, and similar to, that for medium producers. Another product of milk is found only in hilly regions, so the rate of raw milk in Kalimpong is considered here. For the other product, crossbred milk is used more.

xi. Most milk producers sell their output domestically to NDCS agents, middlemen, or consumers or hotels. The milk producers in the hill regions also struggle to establish a smooth, horizontal marketing chain. As a result, instead of selling milk, the milk producers of that area prepare 'Butter' and some by-products like 'Churpi' and then sell those products in the local market to earn from milk production.

xii. It is clear from our sample that local cows are generally reared for domestic consumption of milk, and cross-breeds are mainly for commercial purposes.

xiii. The study found that the overall total cost per day for cross-breed milk is higher than the local milk, and the result is the same for small and medium-sized milk producers. This indicates that as cattle size increases, the marginal cost per day per milch cow decreases for both local and cross-breed milch cows. But milk producers in West Bengal are not benefiting from the marginal cost, as most of them are small (about 96%).

xiv. From the study, it is found that earnings from cross-breed cattle are more than 2.5 times higher than the earnings from local milch cattle. The study has found a positive relationship between gross income and the size of milk producers across breeds of milch animals. The study summarised that the per-day net income from local cattle is severely low at Rs. -54.37, below the cost of cultivation; it is Rs. 10.24 and Rs. 26.88 for medium and large milk producers, respectively. The net income per cross-breed cow per day is Rs. 28.30 for small milk producers, and it is Rs. 145.85 for medium milk producers. The average net income per day per local milch is Rs. 50.99, and it is Rs. 39.30 for cross-breed cattle.

xv. The study has found that the reason behind the critically low net income from specifically local cattle is the low milk yield per day. Low market prices and high feed costs are also important factors contributing to low income from dairy activities in the state of West Bengal.

xvi. The study has adopted the sensitivity analysis with two conditions: a decrease in fodder cost by 5% and an increase in milk yield by 5%. The analysis shows that the percentage change in net income is greatest when both approaches are used together. In comparing these two approaches, the study found that a 5 per cent increase in yield is more effective in increasing income than a 5 per cent reduction in fodder costs. Hence, in general, the policy relating to an increase in yield is found to be more impactful in determining the net income of milk producers than the policy of decreasing fodder cost, but the policy management should also consider the part of the cost related to the implementation to suggest a suitable policy between the above two approaches.

Chapter IV
Break-Even Analysis

4.1 Introduction

Break-Even Analysis (BEA) is a very important concept in the literature and methodology of economics and business accounting. The analytical tools aid in determining the Break-Even Point (BEP), which is critical in any project management's financial decision-making process. BEP is the point at which the revenue covers the product's expenses. In other words, BEP is an inflexion point where total revenue equals total cost, and after that point, profit is made for any production unit. Thus, at BEP, there is no profit or loss situation in any production unit. The standard BEP methodology is the ratio of the Total Fixed Cost (TFC) to the difference between the per-unit selling price and the per-unit variable cost of that product. The BEP is feasible only if the per-unit selling price is greater than the per-unit variable costs of any products; i.e., if the production units are not in a loss situation, then it is not possible to reach the BEP, as the farm is not covering the variable cost. So, it is not possible to reach a no-loss, no-profit zone, i.e., a BEP situation.

The Break-Even Analysis (BEA) is an important tool for assessing the financial situation of dairy operations. Using BEA analysis, this study aims to calculate the break-even point for dairy activities in West Bengal. In the calculation of BEP, the study attempted to describe the BEP at different criterion. One of them is BEP at lactation, considering the total cost as per the cost of cultivation of milk, and the other is BEP at lactation, considering only the paid-out cost. Here in the total cost of the cultivation approach, imputed cost of home labour and inputs is also considered along with actual expenses for purchasing input materials, whereas in the paid-out cost mechanism, only actual expenses are considered and home inputs' imputed cost is deducted from the cost structure. The other mechanism is taken for calculation of BEP in total cost as well as paid out cost for whole cycle instead of lactation periods. Here, the lactation period refers to the milking period only, whereas cycle refers to the addition of the in milk and dry periods of a milch cattle.

The study is also deployed the concept of 'Margin of Safety' (MoS) to determine the risk position of the milk producers. The 'Margin of Safety (MoS)' is the difference between aggregate total sales and 'Break Even Sale (BES)', i.e.

Margin of Safety (MoS) = Aggregate Actual Sale – Break Even Sale

$$\text{Margin of Safety (MoS) Ratio (\%)} = \frac{\text{Agrregate Actual Sale} - \text{Break Even Sale}}{\text{Agrregate Actual Sale}} \times 100$$

A high MoS ratio indicates actual production is above the BEP level, and vice versa. The production level excess over the BEP margin is the power of the producers to prevent the production unit from unforeseen sudden shocks. As a result, a milk-producing unit will always prefer to maintain a higher margin of safety in order to protect the production system from short-term shocks.

In the analysis, all the calculations stated above are shown in the following table for the state of West Bengal.

4.2 Breakeven Level

The study has also calculated the Break-Even Point (BEP) and Margin of Safety (MoS) for milk production in West Bengal. The results of the BEA are described in the following tables: 4.1 to 4.4. At first, the BEA is calculated for each milk animal per lactation period using the cultivation cost approach for the state of West Bengal. From Table 4.1, it is found that the overall BEP per litre cannot be estimated, as the average variable cost exceeds the average selling price; hence, the milk producers are already in losses and are not covering the operational expenses from milk production. The overall BEP per cross-breed milch per lactation is 167.90 litres, as observed for the sample study in West Bengal. Across milk producers, it is found that small local milk producers are also facing operational losses, i.e., the average variable cost per litre is higher than the selling price per litre; hence, BEP estimation is not possible. The table also postulates that the BEP level for both local cattle and cross-breed cattle is lowest for medium-sized milk producers. The overall percentage of the MoS ratio, i.e., the strength of risk prevention, is not feasible for local milk animals due to the milk production units presently running at a loss as per the cost of cultivation. Across milk producer sizes, the MoS ratio is highest for medium-sized producers. The MoS ratio is not feasible for small local milk producers, as they are running at a loss due to cultivation costs. The table also shows the percentage of BEP relative to total output, indicating how BEP is distributed across total output. The lower the ratio, the healthier it is for the production unit to reach the no-profit-no-loss position and then start making net profit over all input costs. From the table, it is found that the overall percentage of BEP to total output

for local cattle cannot be calculated because BEP is not estimated, as the average variable cost per litre of milk is higher than the average selling price of milk per litre, and it is 10 % for the milk producers with cross-breed cattle. Across milk producer sizes, the percentage is lower for medium-sized producers.

Table 4.1: BEP of Milk Production of In-Milk Animal/Lactation of Selected Households

Sr. No	Particulars	BEP- In-Milk animals/lactation (Rs/animal)											
		Small			Medium			Large			All		
		LC	CB	B	LC	CB	B	LC	CB	B	LC	CB	B
1	Fixed Cost/Animal	711.87	1215.78	-	224.40	1335.49	-	400.91	-	-	671.17	1220.64	-
2	Variable Cost /Animal	32112.65	45813.08	-	14969.11	28556.96	-	13213.65	-	-	31005.29	44897.47	-
3	Total Cost/Animal	32824.52	47028.86	-	15193.51	29892.45	-	13614.56	-	-	31676.46	46118.10	-
4	Milk Yield	566.02	1654.17	-	498.75	2091.22	-	710.66	-	-	561.37	1679.66	-
5	Average Selling Price/ Litre of Milk	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
6	Average variable cost per litre of milk	56.73	27.70	-	30.01	13.66	-	18.59	-	-	55.23	26.73	-
7	Break Even Point (litre)	NE	229.20	-	56.29	59.77	-	62.58	-	-	NE	167.90	-
8	Margin of Safety Ratio (%)	-	86.1	-	88.7	97.1	-	91.2	-	-	-	90.0	-
9	% of BEP to total output	-	13.9	-	11.3	2.9	-	8.8	-	-	-	10.0	-
Source: Authors' Calculation from Field Survey Data													

Instead, the cost combination for milk production, if the study considered only the paid-out cost, i.e., the actual physical cost incurred by the dairy farmers, excluding their own imputed costs, yields results that are significantly different from those in the previous table, as shown in the following table 4.2. In the following table, it is found that all the BEPs are feasible, as no milk producers incur losses under the paid-out cost. The table also found that the overall BEP was lower for local cattle (52.28 litres) than for cross-breed cattle (53.83 litres), and across milk producer sizes, the results are the same. In the paid-out cost, the MoS ratio is also feasible for both local and cross-breed cattle, and the table shows that the risk factor associated with milk production is higher for milk producers with local cattle than for those with cross-breed cattle. Again, across the size of milk producers, it is found that the risk position is higher for small milk producers than the medium and large milk producers. In the percentage of BEP to total output, the result is also far better than the cost of the cultivation approach component shown in the above table 4.2. The overall percentage of BEP to total

output is lower for cross-breed cattle (3.2%) compared to local cattle (9.3%) milk producers. Across the size of milk producers, the result is better for medium-sized milk producers than the others.

Table 4.2: BEP of Milk Production of In-Milk Animal/Lactation of Selected Households-Paid out Cost

Sr. No	Particulars	BEP- In-Milk animals/lactation (Rs/animal)											
		Small			Medium			Large			Overall		
		LC	CB	B	LC	CB	B	LC	CB	B	LC	CB	B
1	Fixed Cost/Animal	711.87	1215.78	-	224.40	1335.49	-	400.91	-	-	671.17	1220.64	-
2	Variable Cost /Animal	10299.40	19457.43	-	6801.92	12800.17	-	6232.63	-	-	10195.24	19018.37	-
3	Total Cost/Animal	11011.28	20673.20	-	7026.33	14135.67	-	6633.54	-	-	10866.42	20239.00	-
4	Milk Yield	566.02	1654.17	-	498.75	2091.22	-	710.66	-	-	561.37	1679.66	-
5	Average Selling Price/ Litre of Milk	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
6	Average variable cost per litre of milk	18.20	11.76	-	13.64	6.12	-	8.77	-	-	18.16	11.32	-
7	Break Even Point (litre)	55.60	57.25	-	11.02	44.70	-	24.70	-	-	52.28	53.83	-
8	Margin of Safety Ratio (%)	90.2	96.5	-	97.8	97.9	-	96.5	-	-	90.7	96.8	-
9	% of BEP to total output	9.8	3.5	-	2.2	2.1	-	3.5	-	-	9.3	3.2	-
Actual Expenditure towards input costs is considered as paid out costs Source: Authors' Calculation from Field Survey Data													

The study has also adopted the BEA throughout the dairy cycle. i.e., a milk animal's milk and dry periods combined. Initially, the BEA assumed the cultivation costs for the cycle, and then used the paid-out costs approach. From Table 4.3, it is found that the total cost per animal per cycle is higher for crossbred cattle milk producers (Rs. 70859.40) than for local milch cattle milk producers (Rs. 59923.84). Across the size of milk producers, it is found that the cost per milch of cycle is reduced with the increase in the size of milk producers.

In the cycle BEP calculation, the study first calculated it using cultivation cost approaches, as shown in Table 4.3, and then calculated it using the paid-out cost concept, as shown in Table 4.4. From Table 4.3, it is found that, overall, the BEP for the cycle of both local milch cattle and cross-breed milch cattle cannot be estimated, as the average variable cost per litre of milk is much higher than the average selling price per litre of milk. This indicates that, in a cycle, both local and cross-breed milch cattle milk producers are in a loss position, i.e., not covering

their variable costs through milk sales. The MoS ratio and the percentage of BEP to total output are also infeasible due to BEP is not estimated. Across milk producer sizes, only medium cross-breed milk producers have realised positive revenue per litre over cost per litre over a cycle.

Again, the result of the BEA approach, with the paid-out cost for a cycle, is shown in Table 4.4. With the paid-out cost, the overall BEP for cycle is showing feasible (119.43) for only cross-breed cattle, and for the local milk producers, the BEP cannot be estimated. Across the size of milk producers, it is found that small local milch milk producers are faced losses and not cover the cost from the selling price of per litre milk, hence, the BEP cannot be calculated. The medium milk producers earn some profit over cost of milk production.

Table 4.3: BEP of Milk Production of Milch Animal/Cycle of Selected Households

Sr. No	Particulars	BEP- in Milch animals/Cycle (Rs/animal)											
		Small			Medium			Large			Overall		
		LC	CB	B	LC	CB	B	LC	CB	B	LC	CB	B
1	Fixed Cost/Animal	1363.51	1928.57	-	444.68	2012.93	-	840.94	-	-	1297.18	1926.47	-
2	Variable Cost /Animal	61508.10	72672.51	-	29662.79	43042.58	-	27716.61	-	-	59923.84	70859.40	-
3	Total Cost/Animal	62871.60	74601.07	-	30107.47	45055.51	-	28557.56	-	-	61221.02	72785.87	-
4	Milk Yield	566.02	1654.17	-	498.75	2091.22	-	710.66	-	-	561.37	1679.66	-
5	Average Selling Price/ Litre of Milk	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
6	Average variable cost per litre of milk	108.67	43.93	-	59.47	20.58	-	39.00	-	-	106.75	42.19	-
7	Break Even Point (litre)	NE	NE	-	NE	130.56	-	NE	-	-	NE	NE	-
8	Margin of Safety Ratio (%)	-	-	-	-	93.8	-	-	-	-	-	-	-
9	% of BEP to total output	-	-	-	-	6.2	-	-	-	-	-	-	-

Source: Authors' Calculation from Field Survey Data. NE = Not Estimated as variable cost per litre exceeds the sale price per litre, - = Cannot be calculated

From the above analytical discussion, it is clear that the picture of dairy activities in West Bengal is miserable. In the comparison of the total cost and paid-out cost approaches, it is evident that the milk producers are not operating as professional production units. Here, it is found that farming activities are continuing in a severe loss situation, but one milk production unit will not proceed with production due to operational losses.

Table 4.4: BEP of Milk Production of Milch Animal/Cycle of Selected Households-Paid out Cost

Sr. No	Particulars	BEP- in Milch animals/Cycle (Paid Out) (Rs/animal)											
		Small			Medium			Large			Overall		
		LC	CB	B	LC	CB	B	LC	CB	B	LC	CB	B
1	Fixed Cost/Animal	1363.51	1928.57	-	444.68	2012.93	-	840.94	-	-	1297.18	1926.47	-
2	Variable Cost /Animal	19727.33	30864.98	-	13478.69	19293.10	-	13073.40	-	-	19704.32	30015.73	-
3	Total Cost/Animal	21090.84	32793.55	-	13923.37	21306.03	-	13914.34	-	-	21001.50	31942.20	-
4	Milk Yield	566.02	1654.17	-	498.75	2091.22	-	710.66	-	-	561.37	1679.66	-
5	Average Selling Price/ Litre of Milk	31.00	33.00	-	34.00	36.00	-	25.00	-	-	31.00	34.00	-
6	Average variable cost per litre of milk	34.85	18.66	-	27.02	9.23	-	18.40	-	-	35.10	17.87	-
7	Break Even Point (litre)	NE	134.48	-	63.75	75.18	-	127.34	-	-	NE	119.43	-
8	Margin of Safety Ratio (%)	-	91.9	-	87.2	96.4	-	82.1	-	-	-	92.9	-
9	% of BEP to total output	-	8.1	-	12.8	3.6	-	17.9	-	-	-	7.1	-

Source: Authors' Calculation from Field Survey Data. NE = Not Estimated as variable cost per litre exceeds the sale price per litre, - = Cannot be calculated

The sample milk producers are continuing dairy activities by covering the paid-out cost, which is what they have actually incurred for the dairying activities, but they have compromised the imputed part of the costs. The waste and by-products from cultivation are used as the main fodder in the state of West Bengal. Most milk producers are also cultivators, so the importance of continuing milk production lies in using waste and by-products as cattle fodder without incurring significant actual paid-out costs.

4.3 Chapter Summary

i. It is found that overall earnings per litre for the lactation period are negative for the in-milk local milch animal, which is indicated by the high average variable cost over the sale price per litre of milk, not covering the part of operational expenses by producing milk. The overall BEP per cross-breed milch per lactation is 167.90 litres, as observed for the sample study in West Bengal. Across milk producer sizes, small local producers are facing operational losses.

   However, for the paid-out cost, the BEP for the lactation period shows that all the BEPs are feasible, as no milk producers are facing losses. The table also found that the overall BEP was lower for local cattle (52.28 litres) than for cross-breed cattle (53.83 litres), and that across all milk producer sizes, the results are the same.

ii. During the lactation period, the MoS ratio is highest, i.e., the risk position is lowest, for medium-sized milk producers. The MoS ratio is not feasible for small local milk producers, as they are operating at a loss due to total cultivation costs.

But in terms of paid-out costs, the MoS ratio is also feasible for both local and cross-breed cattle, and the risk factor associated with milk production is higher for milk producers with local cattle than for those with cross-breed cattle. Again, across milk producer sizes, the risk position is higher for small milk producers than for medium and large milk producers.

iii. The overall percentage of BEP to total output per lactation can be for cross-breed milch, but for local it is infeasible, as BEP is not calculated because the average variable cost per litre is higher than the average selling price, i.e., the sector is already in a loss position. Across milk producer sizes, the percentage is lower for medium-sized producers.

However, as per the paid-out cost, the overall BEP-to-total-output percentage is lower for cross-breed cattle (3.2%) than for local cattle (9.3%) milk producers. Across the size of milk producers, the result is better for medium-sized milk producers than for the others.

iv. It is found that the overall BEP for the cycle of both the local milch cattle and cross-breed milch cattle cannot be estimated, as for the cycle, the average variable cost per litre of milk is much higher than the average selling price per litre of milk. This indicates that, in a cycle, both local and cross-breed milch cattle producers are at a loss.

However, with the paid-out cost, the overall BEP for the cycle is feasible (119.43) for only cross-breed cattle, and for local milk producers, the BEP cannot be estimated. Across milk producers, small local producers incur losses and cannot cover the cost of milk per litre from its selling price; hence, the BEP cannot be calculated. Medium milk producers earn some profit above the cost of milk production.

v. In the comparison of analysis between the total cost approach and the paid-out cost approach, it is evident that the milk producers are not operating as professional production units, as here the farming activities are continuing with a severe loss situation, but a professional milk production unit will not proceed with production after operational losses.

vi. The milk producers in West Bengal are continuing the dairy activities as they cover the paid-out cost part of the lactation period, which is incurred for the dairying

activities, but they have compromised the imputed cost. The waste and by-products from cultivation are used as the main fodder in the state of West Bengal. Most of the milk producers are also cultivators, so the importance behind the continuation of milk production is to use the waste and by-products as fodder for cattle without incurring much actual paid-out costs.

Chapter V
Constraints in Milk Production & Feed Management

5.1 Introduction

This chapter is designed to assess the constraints faced by the milk producers. It will be represented in two stages. First, constraints related to milk production will be shown, and second, constraints of feeding management will be represented. For both purposes, two tables are prepared: one by number of responses and another by percentage. But both the table elicits same story. All the responses are recorded from farmers' perspective.

5.2 Constraints in Milk Production

In Table 5.1, the constraint analysis of milk production indicates that 168 responses agree on high feed costs. 84 percent of households agree or strongly agree that high feed costs are a problem in milk production. It is also evident in our results. The percentage is higher for small producers. Over 60 per cent of households report that the timely non-availability of fodder, especially hay, is a constraint in milk production. The percentage is higher for medium producers. On the contrary, the higher price of milch animals is not a problem for milk production, as they found that value determines a cow's quality. About 50 per cent of households report that low milk yield from milch animals is a problem that calls for breed improvement.

If we consider revenue from milk production, the price of milk plays a pivotal role, along with milk yield. Over 70 percent of the sample households have responded that the milk price should be higher to generate more income from milk sales. It is seen in our analysis that the average per-liter milk rate in West Bengal is slightly higher, at Rs 30, and most of the cows are of the local breed with low milk yield. So, with an increasing cost of feed and fodder, it is found that lower revenue from the sale of milk generates lower profitability in this sector. So, milk price is pivotal in income generation, which is not very high in West Bengal.

Table 5.1: Constraints Faced in Milk Production (in No's of Responses)

Sr.no	Particulars	Small					Medium					Large					Overall				
		SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
1	High Feed cost	0	3	35	161	31	0	0	0	6	3	0	0	0	1	0	0	3	35	168	34
2	Non-Availability of Fodder	1	23	60	126	20	0	1	2	6	0	0	0	0	1	0	1	24	62	133	20
3	High price of milch animal	0	18	134	68	10	0	1	5	3	0	0	0	0	0	1	0	19	139	71	11
4	Low average milk yield of the milk animals	3	49	65	64	49	0	1	4	3	1	0	0	0	1	0	3	50	69	68	50
5	Low milk price (Rs./lit)	0	2	54	78	96	0	0	3	2	4	0	0	0	0	1	0	2	57	80	101
6	High cost of vet. medicines	0	17	56	108	49	0	0	4	3	2	0	0	0	0	1		17	60	111	52
7	Lack of nutritious feed for quality milk production	1	23	107	86	13	0	0	3	6	0	0	0	1	0	0	1	23	111	92	13
8	Poor knowledge about feeding and healthcare	0	23	55	94	58	0	1	4	4	0	0	0	0	1	0	0	24	59	99	58
9	Lack of finance to invest in dairy business for quality milk prod/ Inadequate finance	3	10	99	89	29	0	0	2	4	3	0	0	0	1	0	3	10	101	94	32
10	Lack of veterinary services in villages for quality milk production	16	139	23	34	18	0	7	1	0	1	0	0	0	0	1	16	146	24	34	20

Notes: SD- Strongly Disagree; D-Disagree; N-Indifferent/ Neutral; A-Agree and SA-Strongly Agree.
Source: Field Survey Data

Table 5.2: Constraints Faced in Milk Production (in Percentage)

Sr.no	Particulars	Small					Medium					Large					Overall				
		SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
1	High Feed cost	0	1	15	70	14	0	0	0	67	33	0	0	0	100	0	0	1	15	70	14
2	Non-Availability of Fodder	0	10	26	55	9	0	11	22	67	0	0	0	0	100	0	0	10	26	55	9
3	High price of milch animal	0	8	58	30	4	0	11	56	33	0	0	0	0	0	100	0	8	57	30	5
4	Low average milk yield of the milk animals	2	21	28	28	21	0	11	45	33	11	0	0	0	100	0	1	21	29	28	21
5	Low milk price (Rs./lit)	0	1	23	34	42	0	0	33	23	44	0	0	0	0	100	0	1	24	33	42
6	High cost of vet. medicines	0	7	24	47	22	0	0	44	33	22	0	0	0	0	100	0	7	25	46	22
7	Lack of nutritious feed for quality milk production	0	10	47	37	6	0	0	33	67	0	0	0	100	0	0	0	10	46	38	6
8	Poor knowledge about feeding and healthcare	0	10	24	41	25	0	12	44	44	0	0	0	0	100	0	0	10	25	41	24
9	Lack of finance to invest in dairy business for quality milk prod/ Inadequate finance	1	4	43	39	13	0	0	22	44	34	0	0	0	100	0	2	4	42	39	13
10	Lack of veterinary services in villages for quality milk production	7	60	10	15	8	0	78	11	0	11	0	0	0	0	100	7	61	10	14	8

Notes: SD- Strongly Disagree; D-Disagree; N-Indifferent/ Neutral; A-Agree and SA-Strongly Agree.
Source: Field Survey Data

It is also found that most of the sample households said that the high cost of veterinary medicines, which added an additional part to the cost of milk production, while the lack of nutritious food for animals is not a very severe problem for milk production, as about half of the sample households are neutral about that constraint. About 65 per cent of households admitted they have poor knowledge of feeding and healthcare, calling for increased awareness and proper education in the village on feeding management and healthcare through block livestock development officers and local Pranimitras. Half of the total sample cited inadequate or insufficient finance for investing in the dairy business to produce quality milk as a primary problem, whereas 42 per cent of households are neutral about it. It is found that veterinary services in the sample villages are quite good, as they assure the presence of quality doctors and AI workers.

5.3 Constraints in Feeding Management

Tables 5.3 and 5.4 represent constraints faced in feeding management. The recorded response indicates that 65 per cent of households reported unavailability of green and dry fodder throughout the year, which can be considered a major problem in feeding management. This is severe for both small and medium milk producers. It is also found from the responses that the majority of grazing lands are degraded and encroached. Most households have never heard of PDCS. So, PDCS is needed to develop the dairy sector in West Bengal.

High cost of cattle feed and mineral mixture cannot be considered as a primary problem since half of the sample is neutral. This is probably happening because of the reduced use of cattle feed and mineral mixture. High cost and low returns cannot be considered major problems, as the fodder production culture is not established, and the only source is paddy cultivation. Based on current market rates for hay, cultivation is not favourable. Regarding the diversion of feed and fodder ingredients for industrial use, most households are neutral for the same reason previously mentioned. From the responses, it was found that the lack of sufficient space to tie the animals is not a major problem in feeding management. It is true for both small and medium producers. It is also observed that the farmers have land to cultivate fodder seeds, but as there is a traditional cropping system, no one is attempting for fodder cultivation. Supply of these seeds is adding to the problems.

Table 5.3: Constraints Faced in Feeding Management (in No's of Responses)

Sr.no	Particulars	Small					Medium					Large					Overall				
		SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
1	Unavailability of green/ dry fodder throughout the year	0	38	40	125	27	0	2	2	5	0	0	0	0	0	1	0	40	42	130	28
2	Majority of grazing lands are either degraded or encroached	0	31	52	117	30	0	1	2	4	2	0	0	0	0	1	0	32	54	121	33
3	Irregular & inadequate supply of cattle feed by PDCS	0	0	39	62	129	0	0	1	2	6	0	0	0	0	1	0	0	40	64	136
4	Non-availability of improved fodder seed in the market / PDCS	0	1	37	69	123	0	0	1	3	5	0	0	0	0	1	0	1	38	72	129
5	High cost of cattle feed and mineral mixture	0	1	119	100	10	0	0	5	3	1	0	0	0	1	0	0	1	124	104	11
6	No provision of quality seed on credit	0	2	107	107	14	0	0	3	6	0	0	0	0	1	0	0	2	110	114	14
7	High Cost & Low return on fodder production	0	4	183	39	4	0	1	6	2	0	0	0	0	1	0	0	5	189	42	4
8	Diversion of feed and fodder ingredients for industrial use	0	3	201	25	1	0	0	9	0	0	0	0	1	0	0	0	3	211	25	1
9	Lack of necessary space required for tying the milking animals/ Poor housing	0	67	96	49	18	0	4	2	3	0	0	0	1	0	0	0	71	99	52	18
10	Land is very less therefore cannot afford to put more land under fodder seed/crop production	0	77	74	51	28	0	6	0	2	1	0	1	0	0	0	0	84	74	53	29

Notes: SD- Strongly Disagree; D-Disagree; N-Indifferent/ Neutral; A-Agree and SA-Strongly Agree.
Source: Field Survey Data

Table 5.4: Constraints Faced in Feeding Management (in Percentage)

Sr.no	Particulars	Small					Medium					Large					Overall				
		SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA	SD	D	N	A	SA
1	Unavailability of green/ dry fodder throughout the year	0	17	17	54	12	0	22	22	56	0	0	0	0	0	100	0	17	18	54	11
2	Majority of grazing lands are either degraded or encroached	0	13	23	51	13	0	12	22	44	22	0	0	0	0	100	0	13	23	50	14
3	Irregular & inadequate supply of cattle feed by PDCS	0	0	17	27	56	0	0	11	22	67	0	0	0	0	100	0	0	17	27	56
4	Non availability of improved fodder seed in the market / PDCS	0	0	16	31	53	0	0	11	33	56	0	0	0	0	100	0	0	16	30	54
5	High cost of cattle feed and mineral mixture	0	0	52	43	5	0	0	56	33	11	0	0	0	100	0	0	0	52	43	5
6	No provision of quality seed on credit	0	1	47	47	6	0	0	33	67	0	0	0	0	100	0	0	1	46	48	6
7	High Cost & Low return on fodder production	0	2	80	16	2	0	11	67	22	0	0	0	0	100	0	0	2	79	17	2
8	Diversion of feed and fodder ingredients for industrial use	0	1	87	12	0	0	0	100	0	0	0	0	100	0	0	0	1	88	11	0
9	Lack of necessary space required for tying the milking animals/ Poor housing	0	29	42	21	8	0	44	23	33	0	0	0	100	0	0	0	30	41	21	8
10	Land is very less therefore cannot afford to put more land under fodder seed/crop production	0	33	32	22	13	0	67	0	22	11	0	100	0	0	0	0	35	31	22	12

Notes: SD- Strongly Disagree; D-Disagree; N-Indifferent/ Neutral; A-Agree and SA-Strongly Agree.
Source: Field Survey Data

5.4 Chapter Summary

This chapter is designed to assess the constraints faced by the milk producers. All the responses are recorded from the farmers' perspective.

i. 84 percent of households agree and strongly agree that high feed cost is a problem in milk production. It is also evident in our results. The percentage is higher for small producers. Over 60 per cent of households report that the timely non-availability of fodder, especially hay, is a constraint in milk production. The percentage is higher for medium producers. On the contrary, the higher price of milch animals is not a problem for milk production, as they found that value determines a cow's quality.

ii. About 50 percent of households reveal that low milk yield of milch animals is a problem that calls for breed improvement of milch animals. Over 70 per cent of the sample households have responded that the milk price should be higher to generate more income from milk sales. It is also found that most of the sample households said that the high cost of veterinary medicines, which added an additional part to the cost of milk production, while lack of nutritious food for animals is not a very severe problem for milk production.

iii. About 65 per cent of households admitted that they have poor knowledge about feeding and healthcare, calling for an increase in consciousness and proper education in the village about feeding management and healthcare through block livestock development officers and local Pranimitras. Half of the total sample cited inadequate or insufficient finance for investing in the dairy business to produce quality milk as a primary problem, whereas 42 per cent of households are neutral about it. It is found that veterinary services in the sample villages are quite good, as they assure the presence of quality doctors and AI workers.

iv. The recorded response tells that 65 percent household said an unavailability of green and dry fodder throughout the year was there, can be considered as a major problem in feeding management. It is also found from the responses that most grazing lands are degraded and encroached. Most households have never heard of PDCS. So, PDCS is needed to develop the dairy sector in West Bengal.

v. The high cost of cattle feed and mineral mixture cannot be considered as a primary problem since half of the sample is neutral. This is probably happening because of the reduced use of cattle feed and mineral mixture. High cost and low returns cannot be considered major problems, as fodder production culture is not established. Regarding

the diversion of feed and fodder ingredients for industrial use, most households are neutral for the same reason previously mentioned. From the responses, it was found that the lack of sufficient space to tie the animals is not a major problem in feeding management. It is also observed that the farmers have land to cultivate fodder seeds, but as there is a traditional cropping system, no one is attempting for fodder cultivation.

Chapter VI
Summary and Conclusions

6.1 Introduction

The process of development in dairy activities in India has been widely praised as one of the most successful development programs in the world's most extensive integrated dairy development program, namely 'Operation Flood', often called 'White Revolution' in India. India is ranked first in the world in milk production, followed by the European Union and the United States. Milk production in India has increased from 17 million tonnes in 1950-51 to 209.96 million tonnes in 2020-21, and it accounts for 23 per cent of global milk production. The Central and State governments have initiated several measures to increase livestock productivity, thereby significantly boosting milk production. As per the annual report of the Ministry of Fisheries, Animal Husbandry and Dairying, 2021-22, dairy activity can be considered as an important auxiliary source of income for millions of rural families and serving the most important role in providing employment and income-generating source particularly for marginal farmers as it is evident that most of the milk is producing households are marginal and landless by their land holding category.

There are large inter-regional and inter-state variations in milk production and per capita availability in India. As per the data provided by the National Dairy Development Board, the largest producer of milk is Uttar Pradesh, which produces 16.06 percent of the total milk production in the country, followed by Rajasthan (12.89%) and Madhya Pradesh (8.62%). Most of the milk is produced by animals reared by small, marginal, and landless farmers and labourers. It has been experienced over the years that the stability in dairy income is far stronger than the income realized from agricultural activities. The rural dairy co-operatives were set up to strengthen the social and economic life of rural India.

The impact of the ‘White Revolution’ can be seen in villages through the generation of funds for community development and social welfare, the creation of self-employment opportunities, the promotion of distributive justice, and the removal of the evil of untouchability. This silent social revolution has been relatively smooth and, as a result, even unnoticed by the conservative community. The fact that dairying could play a more productive role in promoting rural welfare and reducing poverty is increasingly recognized.

But in West Bengal, it is partly true that, in some cases, even though there is overproduction, the price of raw milk remains constant. But in most cases, it fails to be a remunerative livelihood source in West Bengal. It is also interesting to see that West Bengal has recorded a total milch population of 7466, i.e., 5.47 % of the total, but contributes only 2.96% to the National milk production, which may suggest a lower productivity of milch animals in West Bengal. Since independence shift from cultivators to agricultural labourers has been significant in West Bengal. So, in the policy perspective it is very essential to generate employment in rural areas. (Majumder et al., 2017) The livestock sector is considered as an integral part of Indian agriculture.

6.2 Main Findings

i. In our sample, it is found that only one household out of the total sample is of large type, i.e. having more than four milch cows. It reveals that if we consider our sample representative of West Bengal, above 95 percent of the sample dairy farmers are smallholders, showing either reluctance toward cow rearing or not considering this culture in a commercial manner. It is also observed that most of the sample households are headed by a male member, which is not uncommon in rural Bengal. It is also observed that in the case of religion, Hinduism dominates significantly over all other religions, implying Hindus' usual religious tendency to rear cows and use domestic milk.

ii. It is observed in our sample that both the total number of animals and the total milch animals are higher for local cattle than for crossbreed. It is found that 71 households have their own funded pucca cattle shed. It is found that the present value of any type of cattle shed is higher than the present value of fodder storage, and the average productive life is lower for a cattle shed than for fodder storage.

iii. Holding of most of the milking assets like milking cans, grass cutter and chopper, and Feed container is increasing across milk producing categories, which is very usual. The earning from job or any service contributes more than any other income source. Income from agriculture and from the sale of milk, cow dung, and urine is increasing across milk-producing groups. Dairy income pushes total annual income to increase. The average milk yield is highest during the rainy season, followed by summer and winter. It is very obvious that in rainy weather, cows eat more, as this is the

harvesting time. The milk yield of both breeds is increasing across milk-producing categories. It is noticed that the average milk rate is lower for the local cow.

iv. Cattle are the only major dairy animals, and buffalo are quite negligible in our sample, at least in the state of West Bengal. Local cattle (LC) have a lower estimated present market value than cross-bred cattle (CB) among small and medium-sized farmers. The average age and average age at first calving are higher for the local cattle (LC) than the cross-breed cattle (CB) across the farming category. The average lactation order is similar for both LC and CB cattle, at around 2.5.

v. The average dry and in milk period for LC milk is much higher than that for CB milk in our study area. The overall dry and milk periods of LC milk are near 245 days and 263 days, respectively, and it is approximately 179 and 309 days for CB. The average milk drawn (two times a day) in milking time is severely lower for the LC cattle (1.54 lit/day) than the CB cattle (4.34), and the average milk drawn (lit/day) of the CB cattle is about 181.82% higher than the LC cattle.

vi. There is no significant difference in feed and fodder quantity consumption between the in milk and dry periods for green fodder and dry fodder across the size of milk producers, but it varies as per the change in season. The consumption of green fodder is significantly higher in the rainy season than it is in the winter. This is due to the free availability green fodder in terms of grass during the rainy seasons. The increase in consumption of green fodder leads to a decrease in the consumption of dry fodder in rainy seasons compared to winter seasons.

vii. The study discovered a significant change in the average price of dry fodder across the size of milk producers and seasons. Respondents in the sample area have reported that no cost is incurred for grazing. The average cost of labour (Rs. per day per milk animal) is about Rs. 66, and almost 99.7% of the total labour cost is contributed by family labour. The average veterinary cost is Rs. 2.27/- per day per milch animal, and the Artificial Insemination (AI) cost is Rs. 244 per year per cattle, respectively. The study has found no transportation cost and a tiny amount of light and water costs in the sample area of West Bengal.

viii. It is clear from our sample that local cows are generally reared for domestic consumption of milk, and cross-breeds are mainly for commercial purposes. The study found that the overall cost per day for cross-breed milk is higher than for local milk, and the same holds for small- and medium-sized milk producers. This indicates

that as cattle size increases, the marginal cost per day per milch cow decreases for both local and cross-breed milch cows.

ix. From the study, it is found that earnings from cross-breed cattle are more than 2.5 times higher than the earnings from local milch cattle. The study has found a positive relationship between gross income and the size of milk producers across breeds of milch animals. The study found that the critically low net income from local cattle is due to low daily milk yield. Low market prices and high feed costs are also important factors contributing to low income from dairy activities in the state of West Bengal.

x. The study has adopted the sensitivity analysis with two conditions: a decrease in fodder cost by 5% and an increase in milk yield by 5%. The analysis shows that the percentage change in net income is greatest when both approaches are used together. In comparing these two approaches, the study found that a 5 percent increase in yield is more effective in increasing income than a 5 per cent reduction in fodder costs.

xi. From the Break-even Point analysis, it is found that the overall earnings per litre for the lactation period are negative for the in-milk local milch animal, which is indicated by the high average variable cost over the sale price per litre of milk, not covering the part of operational expenses by producing milk. The overall BEP per cross-breed milch per lactation is 167.90 litres, as observed for the sample study in West Bengal. Across milk producer sizes, small local producers are experiencing operational losses.

xii. However, for the paid-out cost, the BEP for the lactation period shows that all the BEPs are feasible, as no milk producers are facing losses. The table also found that the overall BEP was lower for local cattle (52.28 litres) than for cross-breed cattle (53.83 litres), and that across all milk producer sizes, the results are the same.

xiii. As per the lactation period, the percentage of the MoS ratio is highest, i.e., the risk position is lowest for medium-sized milk producers. The MoS ratio is not feasible for small local milk producers, as they are operating at a loss due to total cultivation costs.

xiv. But in terms of paid-out costs, the MoS ratio is also feasible for both local and cross-breed cattle, and the risk factor associated with milk production is higher for milk producers with local cattle than for those with cross-breed cattle. Again, across milk producer sizes, the risk position is higher for small milk producers than for medium and large milk producers.

xv. Overall percentage of BEP to total output per lactation can be calculated for cross-breed milch, and for local, it is infeasible as BEP is not calculated due to the average

variable cost per litre being higher than the average selling price, i.e., the sector is already in a loss position. Across milk producer sizes, the percentage is lower for medium-sized producers.

xvi. However, as per the paid-out cost, the overall BEP-to-total-output percentage is lower for cross-breed cattle (3.2%) than for local cattle (9.3%) milk producers. Across the size of milk producers, the result is better for medium-sized milk producers than for the others.

xvii. It is found that the overall BEP for the cycle of both the local milch cattle and cross-breed milch cattle cannot be estimated, as for the cycle, the average variable cost per litre of milk is much higher than the average selling price per litre of milk. This indicates that, in a cycle, both local and cross-breed milch cattle producers are at a loss.

xviii. However, with the paid-out cost, the overall BEP for the cycle is feasible (119.43) for only cross-breed cattle, and for local milk producers, the BEP cannot be estimated. Across milk producers, small local producers incur losses and cannot cover the cost of milk per litre from its selling price; hence, the BEP cannot be calculated. Medium milk producers earn some profit above the cost of milk production.

xix. In the comparison of analysis between the total cost approach and the paid-out cost approach, it is evident that the milk producers are not operating as professional production units, as here the farming activities are continuing with a severe loss situation, but one professional milk production unit will not proceed with production after operational losses.

xx. The milk producers in West Bengal are continuing the dairy activities as they cover the paid-out cost part of the lactation period, which is incurred for the dairying activities, but they have compromised the imputed cost. The waste and by-products from cultivation are used as the main fodder in West Bengal. Most milk producers are also cultivators, so the importance of continuing milk production lies in using waste and by-products as cattle fodder without incurring high actual paid-out costs.

xxi. From the constraint analysis, it is observed that most of the respondents agree that high feed cost is a problem in milk production. It is also evident in our results. The percentage is higher for small producers. Over 60 percent of households say that the timely non-availability of fodder, especially hay, is a constraint in milk production. The higher price of milch animals is not a problem for milk production, as they revealed that value determines a cow's quality.

xxii. About half of the sample households reveal that low milk yield of milch animals is a problem which calls for breed improvement of milch animals. Over 70 percent of the sample households have responded that the milk price should be higher to generate more income from milk sales. It is also found that most of the sample households said that the high cost of veterinary medicines, which added an additional part to the cost of milk production, while lack of nutritious food for animals is not a very severe problem for milk production.

xxiii. Most of the households admitted that they have poor knowledge about feeding and healthcare, calling for an increase in consciousness and proper education in the village about feeding management and healthcare through block livestock development officers and local Pranimitras. Half of the total sample cited inadequate or insufficient finance to invest in the dairy business for quality milk production cannot be considered a primary problem.

xxiv. Unavailability of green and dry fodder throughout the year was there, can be considered as a major problem in feeding management. It is also found from the responses that most of the grazing lands are degraded and encroached. Most households have never heard of PDCS. So, PDCS is needed to develop the dairy sector in West Bengal.

xxv. The high cost of cattle feed and mineral mixture cannot be considered as a primary problem since half of the sample is neutral. This is probably happening because of the reduced use of cattle feed and mineral mixture. High cost and low returns cannot be considered major problems, as fodder production culture is not established. Regarding the diversion of feed and fodder ingredients for industrial use, most households are neutral for the same reason previously mentioned.

xxvi. From the responses, it is found that the lack of necessary space to tie the animals is not a big problem in feeding management. It is also observed that the farmers have land to cultivate fodder seeds, but as there is traditional cropping system no one is attempting for fodder cultivation.

6.3 Conclusions and Suggestions

India still leads the world in milk production, although there are large inter-regional and inter-state variations in both milk production and per capita availability. From the survey statistics, it is found that in West Bengal, dairy farming is carried out at a domestic

subsistence level, but it needs a professional touch with the help of a commercial think tank. This study concludes with the following recommendations to determine the direction in which to develop the dairy business in the state of West Bengal:

i. Feed and fodder costs, the dominant component of the total cost structure, are increasing day by day under the prevailing market mechanism in the dairy business. The situation directly raises the cost of dairy inputs and reduces earnings from dairy activities. There needs to be control over the upward trends in feed and fodder costs. The best strategy suggested by the study is the development of feed and fodder cultivation through the initiative of the PDCS and other governmental or non-governmental organizations. In this study, it is observed that most farmers have land; therefore, ensuring infrastructure for fodder cultivation can be an optimal policy for dairy development in West Bengal.

ii. Another common issue identified in this study is low milk yield in dairy animals. Increasing the yield rate of milch animals is another important issue to consider. Increasing milk yield is not easy, but some strategies can be used. The main problem with the low milk yield is the poor quality of the cattle breeds. The government should take the necessary steps to provide high-yielding breeds and genetic improvement for milch animals.

iii. The study found a lack of support from the local government authorities in providing scientific and technological knowledge to the milk producers. But the local authorities have a crucial role in providing adequate scientific and technological knowledge regarding high-yielding breeds, AI, feeding management, and healthcare to the milk producers at the village level. Hence, the study is recommended to enhance the effectiveness of existing governmental authorities in ensuring adequate scientific knowledge for milk producers at the village level. By increasing the number of milking days in a lactation cycle, proper feeding management and healthcare are needed to improve milk yield and milk production. The sample households are also unaware of animal insurance. Therefore, knowledge of it should be provided through the government. officials.

iv. The main hindrance to dairy activities found in the study is the inadequate earnings from milk production. In this regard, the study has identified another villain: the critical minimum sale price of milk, in addition to the low yield rate. The study blamed the lack of a smooth, horizontal milk market and an improper supply chain for

the low milk sale prices. Most milk producers sell their output domestically to NDCS agents, middlemen, or consumers or hotels. For the milk producers in the hill regions, it is also hard to find such a marketing chain; as a result, instead of selling milk, the milk producers in that area prepare "butter" and some by-products like ‘Churpi’ and then sell those products in the local market, which is considered as main earning from milk production. An efficient marketing system, coupled with an effective milk supply management chain in the village, can solve the problem. So the governing authorities, along with the policy expertise, should be concerned and take immediate action in the state of West Bengal.

v. The cooperative milk unions also have a major role in marketing milk and supply chain management. There are currently 13 cooperative milk unions registered in West Bengal Cooperative Milk Producers Federation Ltd. that procures milk from milk producers at potential villages through the primary milk society. There is a need to increase the number of milk unions and primary milk societies at the village level, with greater operational efficiency across the state's various districts. A special focus is needed on the state's northern region, especially the hilly region, as the milk union is currently not operating in most of the districts in that region.

vi. Policy should encourage milk producers' companies to enter the dairy sector, specifically in milk marketing and supply chain management at the village level.

vii. There are various types of support schemes initiated by the central government and NDDB jointly, but most of the sample farmers are unaware of them, so the benefits are not distributed evenly to the milk producers at the village level. NDDB has developed a number of app-based supporting technologies, such as "e-Gopala" and "Pashumitra" but the majority of people in our sample area are unaware of any of them. There is a need to promote the benefits of such schemes to milk producers, and their smooth implementation is needed immediately in the village.

viii. In the state of West Bengal, most of the milk producers are rearing cattle only to use their agricultural by-products and wastes as fodder for cattle rather than as a profit-making business. Government subsidies for dairy development for all types of milk producers are falling short of their objectives to generate professionalism in milk production. Instead, a target focus group of potential milk producers needs to be set up, and special attention is needed to provide them with the benefits of the various developmental schemes to create a group of productive and potential milk producers for the development of the dairy sector.

ix. Availability of credit for the purchase of high-yielding animals is another possible wheel for developing the dairying sector in the state of West Bengal. Most of the milk producers in this study agree that the lack of finance for dairy activity is a major constraint for dairy. Availability of credit facilities with subsidised interest rate can also develop the concerning sector towards an optimum level.

x. Others incentive like subsidised bio-gas unit should be given to the large milk producers which may increase their income from dairy in one hand and on the other hand that may give an encouragement to others for rearing a large number of milch animals, as a result numbers professional large milk producers will be increased in the dairy sectors in West Bengal.

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Annexure-1

Focus Group Discussion

1.1 Name of Village_____1.2 Nearby Town Name _____Distance _____(kms)

1.3 Name of District_____ 1.4 Name of State _____1.5 No. of participants ____

2.1 Agriculture Seasons (write the period- from to months): 2020-21

Rainy _____ Winter_____ Summer_____

2.2 Milk Yield (lit/animal/day) along with fat %: 2020-21

Particulars	Rainy	Winter	Summer
LC			
CB			
B			

2.3 Labour Rate (Rs/day for 8 hours): 2020-21

M/F	Rainy	Winter	Summer
Male			
Female			

2.4 Average Life Cycle of in Milch Animals

Animal		Average Life Cycle of in Milch Animals									
	Age at first heat (months)	Services per conceptions (No.)		Service period from first attempt till the success (days)	Av. Age at first calving (months)	Lactation length (days)	Dry Period (days)	Avg. No of lactations in life	Av. Productive life (years)	Life after last lactation (years)	Av. Age of calf at Sale (months)
		AI	Natural								
LC											
CB											
B											

2.5 Cost of rearing an animal till first calving or Induction of Animal and Disposal Method

Animal	Cost of rearing calf till first calving(Rs.)	Cost of Induction of animal after **1st lactation** (Rs./animal)	**Salvage Value** of adult animal (Rs.)	Rearing charges – unproductive animal (Rs./month)	Rate of Animal shed Land in village **(Rs./sqft)**
LC					
CB					
B					

2.6 Fodder Consumption for Milch Animal (Kgs / day / animal)

Sr. No.	Animal	Av. Quantity **(Kgs / day / animal)**							
		In milk				**Dry Period**			
		Green Fodder	Dry Fodder	Supplements	Concentrates	Green Fodder	Dry Fodder	Supplements	Concentrates
1	LC								
2	CB								
3	B								

Note –*Take actual quantity of fodder consumed (do not include quantity of wastage)*

2.7 Milk Rate (Rs. per Litre) received from different Agencies and dividend received: Please collect PDCS Rate list

Animal	**Milk Rate (Rs. per Litre)----- (Milk directly sell by milk producer to)**									
	Rainy and Winter Season					**Summer Season**				
	PDCS	Consumer	Private Dairy / Agent	Sweet Shop, Hotel, Marriage, etc.	Range of fat (%)	PDCS	Consumer	Private Dairy / Agent	Sweet Shop, Hotel, Marriage, etc.	Range of fat (%)
Rs. per Litre										
LC										
CB										
B										
Bonus/ Dividend %										

2.8 Prevailing Bank Interest rate (Per Cent / annum) charged by the banks/societies:

Rate of Interest charged (**Per Cent / annum**)						Interest on loan for Equipment (%)	**Insurance premium** paid (amount / animal / annum)
Purchase of Livestock			**Cattle shed**				
Bank	Cooperative Credit Soc.	Informal sources	Bank	Cooperative Credit Soc.	Informal sources		

Note: Informal sources- money lenders, relatives, friends, etc.

2.9 Name of Fodder Crops (By-product and Main Product) Grown in the Area:

Particulars	Fodder Crop available				
	By product/ sole crop	Crop Name1	Crop Name 2	Crop Name 3	Crop Name 4
Kharif	Cereals and Pulses				
	Oilseeds				
	Sugarcane top				
	Fodder Crop				
Rabi	Cereals and Pulses				
	Oilseeds				
	Sugarcane top				
	Fodder Crop				
Summer	Cereals and Pulses				

	Oilseeds				
	Sugarcane top				
	Fodder Crop				

2.10 Average Market Value (Rs/Unit)

Sr. No.	Assets	Purchase Value **(Rs/Unit)**	Sr.	Assets	Purchase Value **(Rs/Unit)**
1	Milk cans (aluminum / steel) – 10 lit		8	Grass Chopper	
	20 lit 40 lit		9	Fan	
2	Milking Machine		10	Fogger	
3	Grass Cutter		11	Biogas unit	
4	Fodder Chaffer-Manual		12	Tractor trolley	
5	Fodder Chaffer Power		13	Large auto(material shifting)	
6	Fodder harvester/ mowers		14	Mosquito net	
7	Feed Mixer/ TMR mixer		15	Other 1, if any (specify)	

Annexure-2

Milk Producer Household Survey Schedule

[1] Identification of Dairy Household

(Are you a member of Milk Producer's Cooperative Society -Yes/ No)

1. State		2. District		3. Taluka/Mandal		4. Village	
5. Name of Household Head (HH)					6. Gender of HH	*1:Male/ 2:Female*	
7. Age (years) of HH		8. Education (years) HH			9. Mobile		

[2] Socio-Economic Characteristics (*please write code, number, or tick as applicable*)

1. Religion (code) (*1:Hindu, 2:Muslim, 3:Christian, 4:Sikh, 5:Others)*		3. Occupation- (code) *1:Cultivator, 2:AH & D, 3:Agri. Labour, 4:Nonfarm Labour, 5:Own Non-Farm Establishment, 6:Trade, 7:Employee in Service, 8:Other*	Principal	
2. Social Group (*1:ST, 2:SC, 3:OBC, 4:Open)*			Subsidiary	
4. Income Group(1:APL/2:BPL/3:AAY)		5. Landless (write -0)/ Operational Holdings (ha)- Agri		
6. Details of Family:- Members : M: F: C (below 15 years): Work in Dairy: M: F: C (below 15 years):				

[3] Source-wise Farmer's Household Income (in Rs.) -Agriculture Year 2020-21

Sl	Sources of Gross Income (in Rs) Agriculture Year 2020-21	Annual Gross Income (Rs)
1	Agriculture /Cultivation	
2	Agriculture Labour /Wages	
3	**Animal Farming** (Sale of milk, Dung/FYM, Urine)	
4	**Animal Farming – Sale of Animal- nos.**	
5	Non-Farm Employment-business/Self Employment	
6	Service	
7	Any Other	

[4] Cattle Shed and Fodder Storage

Building/ Shed		Cattle Shed-CS			Fodder Storage-FS		
		No.	Present Value	How old (years)	No.	Present Value	How old (years)
Pucca **Size- sq ft**	1 Owned fund/ 2 borrowed fund =						
	Subsidy received if any						
Kachcha **Size- sq ft**	Owned fund						
	Subsidy received if any						

[5] Holding of Productive Assets (Dairy)

Sr.	Assets	No.	Total Purchase Value	How old (years)	Subsidy received, if any with the	Sr.	Assets	No.	Total Purchase Value	Year of Purchase	Subsidy received if any with the year (Rs./unit)
1	Milk cans (aluminum/ steel)					7	Feed Mixer/ TMR mixer				
2	Milking Machine					8	Grass Chopper				
3	**Grass Cutter**					9	Fan, fogger				
4	Fodder Chaffer-Manual					10	Biogas unit				
5	Fodder Chaffer Power					11	Tractor trolley				
6	Fodder harvester/ mowers					12					

[6] Herd Strength (Numbers)- on the day of the survey

Variety	Milch animals (Number)				**Other animals (Number)**					**Insurance (milch animals)**	
	In milk		dry		Heifer		Calves		adult male	(Rs./animal)	
	In Milk Not Pregnant	In Milk And Pregnant	Dry and Pregnant	Dry and Not Pregnant	Not Calved even Once	Pregnant Heifer	Male	Female		Nos	Amount
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Local Cattle (LC)											
Cross Breed (CB)											
Buffalo (B)											

[7] Details on Milk Yield (Lit/day/animal), Milk Rate (Rs. Lit)

Sr. No.	Av. Milk Yield (lit/animal/ per day) 2020-21				Av. Milk Rate (Rs. lit) 2020-21		
	Animal	Rainy	Winter	Summer	Rainy	Winter	Summer
1	**Discrete**						
	Other LC						
2	**CB**						
3	**B**						

[7] Details of <u>Milch Animals</u> (Dry + In Milk) on <u>Survey Date …….Individual animal wise data (see Table 6)</u>

Sr. No.	Animal	breed	Dry /In Milk	Estimated Present market value (Rs.)	Age of Animal (Years)	Age at first calving (months)	Lactation Order@	**Dry Period (in days)**	**In Milk period (days)**	**Milk Drawn (lit/day) two times - yesterday**
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Note: Code the animals in the second column for **Local cattle as LC1, LC2**…; **Cross Breed as CB1, CB2**…and **Buffalo as B1, B2**…

[8] Feed and Fodder Consumption (Kgs/day/animal) and Price (all Milch Animals)

Sr. No	Fodder Types	**Feed management and Price (Rs/ Kg)**			**Fodder Consumption/ feed and fodder consume (Kgs/day/animal)**					
					In milk period			**Dry Period**		
		Home (kg)	Purchased (kg)	Market Rate (Rs./kg)	**LC**	**CB**	**B**	**LC**	**CB**	**B**
A	**Green-Fodder**									
1										
2										
3										

B	**Dry Fodder**									
1										
2										
C	**Concentrates**									
1										
2										
D	**Supplements**									
1										
2										
E	**Grazing hours /day**									
F	**Grazing cost/ month**									

Note: In case if all animals are fed together the joint cost of feed will be apportioned applying the standard animal units approach' and also the proportion should be told per breed.

[9] Feed and Fodder Consumption (Kgs/day/animal) and Price- earlier seasons

Sr. No	Fodder Types	Rainy Season						Summer Season					
		All animals			Milch animals			All animals			Milch animals		
		Home (kg)	Purchased (kg)	Market Rate (Rs./kg)	LC	CB	B	Home (kg)	Purchased (kg)	Market Rate (Rs./kg)	LC	CB	B
A	**Green-Fodder**												
1													
2													
3													
B	**Dry Fodder**												
1													
2													
C	**Concentrates**												
1													
2													
D	**Supplements**												
1													
2													
E	**Grazing hours /day**												
F	**Grazing cost/ month**												

Note: In case if all animals are fed together the joint cost of feed will be apportioned applying the standard animal units approach' and also the proportion should be told per breed

[10] Cost of Milk Production Labour & Other expenditure: Wage Rate- for <u>8 hours</u>: Male-Rs. Female- Rs.

Sr. No		Family Labour		Hired Labour		Other Expenditures (Rs./ Annum)				
	Animal **breed**	Male (hours minutes)	Female (hours)	Male (hours)	**Female (hours)**	**Veterinary Cost plus vaccination, deworming, etc**	**AI cost Rs/year**	**Transport cost**	**Repair/ Maintenance Cost of equipment/ Home**	**Light & Water charges purchased**
Milch (dry+ in milk) animals										
Other animals										

[11] Income in Dairy (in milk animals)- sale of milk

Sr. No	Animal Type	in milk										
		Milk Household use/ day (lit)	Sale of milk **(per day) In Milk animals**						Self-Use /Sale of FYM/Cow dung (**Rs/Annum)**		Sale -Animal Urine* (Rs/**Annum)**	
			Coop Society		Private Dairy/Agent		Consumer, hotel, etc					
			Sale (lit)	(Rs./Lit	Sale (lit)	(Rs./Lit	Sale (lit)	(Rs./Lit)	Self-use/Sell	Amount (Rs)	Value	Sold to
1	LC											
2	CB											
3	B											

Notes: 1 Coop society, 2- Agents, 3- Consumers, 4. Private Companies; 5 Others.

[12] Constraints Faced in Milk Production and Feeding Management

(5: Strongly agree, 4: Agree, 3: Indifferent/Neutral, 2: disagree, 1: Strongly disagree)

Sl	Milk Production- Constraints	Rating	Sl	Feeding Management -Constraints	Rating
1	High Feed cost		1	Unavailability of green/ dry fodder throughout the year	
2	Non Availability of Fodder		2	The majority of grazing lands are either degraded or encroached	
3	High price for milch animal		3	Irregular & inadequate supply of cattle feed by **PDCS**	
4	Low average milk yield of the milk animals		4	Non-availability of improved fodder seed in the market / PDCS	
5	Low milk price (Rs./lit)		5	High cost of cattle feed and mineral mixture	
6	High cost of veterinary medicines		6	No provision of quality seed on credit	
7	Lack of nutritious feed for quality milk production		7	High Cost & Low return on fodder production	
8	Poor knowledge about feeding and healthcare		8	Diversion of feed and fodder ingredients for industrial use	
9	Lack of finance to invest in the dairy business		9	Lack of necessary space required for tying the milking animals	
10	Lack of veterinary services in villages		10	Land is very less, therefore, cannot afford to put more land under fodder	

Annexure-3

Comments by the Coordinator of the Study on the Draft Report and Action Taken

1.	Title of report	Cost of Milk Production and Returns to the Milk Producers in West Bengal
2.	Date of receipt of the Draft report	December 27, 2022
3.	Date of dispatch of the comments	March 17, 2023
4.	Comments on the Objectives of the study	As per the approved study proposal
5.	Comments on the methodology	As per the methodology suggested by the Coordinator of the Study
6.	Comments on analysis, organization, presentation, etc.	The analysis is proper. Check and correct the BEP estimates (Tables 4.1 and 4.2) [**Action:** Table 4.1 and 4.2 have rechecked and revised the table]
7.	References	Adequate and Proper. Some cited references in the text are missing from the reference list [**Action:** Necessary changes made and revised the references]
8.	General remarks:	
	• Preface- Correction in name [**Action:** Necessary changes made as suggested] • Abbreviations: Delete repeated ones [**Action:** Necessary changes made to avoid repetition] • Use past tense instead of Simple future (Data and Methodology) [**Action:** Necessary changes made as suggested] • Dairy occupation of large farmers is missing in Primary and Secondary Occupations (Table 2.3) [**Action:** Necessary changes made as suggested and revised the table 2.3] • The same data pertaining to Milk Drawn (lit/day) is reported two times -for the whole cycle and milk drawn two times (Table 3.1), check and correct [**Action:** Necessary changes made as suggested and revised the table 3.1] • Tables 3.10, 3.11, 3.12 - Calculation of net income Increase by reduction or increase is not correct, please re-check [**Action:** Necessary changes made as suggested and revised the table 3.10, 3.11,	

	3.12] • Author is requested to read the report carefully to observe proper flow and incorporate the comments [**Action:** Necessary changes made as suggested]
9.	Overall view on the acceptability of the report:
	• The report may be finalized as State Report after incorporating the corrections mentioned above and highlighted on the soft copy report. [**Action:** The final report is thoroughly revised and incorporated all the comments]

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