PRODUCTIVITY AND TECHNICAL EFFICIENCY OF DAIRY FARMING IN SOME SELECTED AREAS OF DHAKA DISTRICT IN BANGLADESH

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CERTIFICATE

*This is to certify that the thesis entitled "**PRODUCTIVITY AND TECHNICAL EFFICIENCY OF DAIRY FARMING IN SOME SELECTED AREAS OF DHAKA DISTRICT IN BANGLADESH"** submitted to the Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in AGICULTURAL ECONOMICS,** embodies the result of a piece of bona fide research work carried out by* **Atika Rahman**, *Registration No.* **15- 06890** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Date: 4 June, 2023

Place: Bangladesh

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DEDICATED

TO

MY BELOVED

PARENTS

&

HUSBAND

ABSTRACT

Livestock is one of the sectors in Bangladesh that is expanding the fastest. Dairy farming has become more important because of its numerous uses. Monthly revenue is guaranteed in dairy farming. Milk is commonly consumed by humans as it is a good source of nutrients. However, the supply of milk in our nation does not keep up with the demand. Milk production must be increased to close the gap between supply and demand. By improving the technical efficiency of milk production using the existing systems, milk production can be increased. Hence the objective of the present study was to identify the socio-economic characteristics of dairy farmers, measure the productivity and technical efficiency of dairy production, and address the challenges faced by farmers in the study area as well as to suggest policy options to minimize the problems. A Cobb-Douglas stochastic frontier production function was used to accomplish these objectives. Primary data was collected from 120 randomly selected farmers from the Savar Upazila in Dhaka district. The results indicated that the coefficients of parameters such as family labor cost, hired labor cost, concentrate feed cost, roughage feed cost and utility cost were positive, with family labor cost and utility costs being highly significant. On the other hand, the coefficient of veterinary cost was negative and highly significant. The technical inefficiency effect model revealed that factors such as education, farm experience, training and veterinary service had negative coefficients, indicating that they help in reducing the technical inefficiency of dairy farmers. In terms of the challenges faced by farmers, the high feed cost, lack of capital and lack of marketing facilities were identified as the top three concerns. To address these challenges and enhance dairy production, it is recommended to provide subsidies for purchasing inputs like better breeds of milking cows, cultivating green fodder, buying concentrated feed etc. Also provide training facilities about dairy modern farming, adequate veterinary services and offer accessible credit. This study will provide an important insight for the concerned authority and help to boost dairy production

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June,2022
Atika Rahman

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ABBREVIATIONS AND ACRONYMS

BBS	Bangladesh Bureau of Statistic
BER	Bangladesh Economic Review
FAO	Food and Agricultural Organization
et al.	and others (at elli)
GDP	Gross Domestic Product
HIES	Household Income and Expenditure Survey
kg	Kilogram
Ln	Natural Logarithm
ML	Maximum Likelihood
ml	Millilitre
NGO	Non-Government Organization
No.	Number
Tk.	Taka
%	Percentage

CHAPTER 1
INTRODUCTION

1.1 Background to the Study

Bangladesh's economy is one of the fastest-growing in the world. Its record of development and poverty alleviation is impressive. When Bangladesh was founded in 1971, it was among the world's poorest nations, but in 2015 it achieved low-middle income status. It is anticipated to leave the list of the Least Developed Countries (LDC) of the United Nations by 2026. Bangladesh has made outstanding progress toward achieving food security despite a high population density, dwindling arable land, and frequent natural disasters. After the worldwide COVID-19 pandemic, Bangladesh's economy has demonstrated a steady recuperation from its consequences.

Main macroeconomic goals like creating jobs, reducing poverty, developing human resources, ensuring food security, and other economic and social forces are all impacted by the agriculture sector. The 8th Five Year Plan, Vision'41, National Agricultural Policy 2018, Deltaplan-2100, Sustainable Development Goals, National Adaptation Plan of Bangladesh (2023–2050), and other planning documents, the government has been working tirelessly to promote the overall growth of the agriculture sector (BER, 2022).

Bangladesh Bureau of Statistics (BBS, 2021) reports, Crops, livestock, fisheries, and forest products amounted for around 12.09 percent of total GDP in Bangladesh and employed approximately 40% of the entire population. The majority of Bangladesh's agricultural output is classified as traditional subsistence agriculture. The BBS's preliminary estimate states that the agriculture sector grew by 2.20 percent in 2022 compared to 3.17 percent in the previous fiscal year. Throughout this time, amongst the four sub-sectors of the larger agriculture sector: the growth rate of crops and horticulture, fishing has diminished while the growth rate of animal farming and forest and related services has enlarged compared to earlier fiscal year. According to the Bangladesh Economic Review (BER), the nation is currently on the verge of achieving food production self-sufficiency. The broad agricultural sector which includes crops, animal farming, forests and fishing contributes 11.50 percent to GDP, provides employment about 40.60 percent of the labor force (BER, 2022).

Among them Livestock is vital to the economy. Incorporating dairy and other animal-based goods generates money and allows for savings for future needs. It can also supply transportation, as well as fuel and farming inputs. (like power and manure). Consequently, the industry contributes significantly to enhancing resilience, decreasing poverty, and eliminating food insecurity and malnourishment.

1.1.1 Agriculture in Bangladesh

Following independence, Bangladesh's economy has grown more rapidly thanks to the agriculture sector. But its contribution has reduced, going from 13.14 percent in fiscal year 2017-18 to 11.50 percent in fiscal year 2021-22 (BBS,2021). Figure 1.1 depicts at constant prices the decreasing trend of agriculture's share of GDP (Base Year: 2015-16).

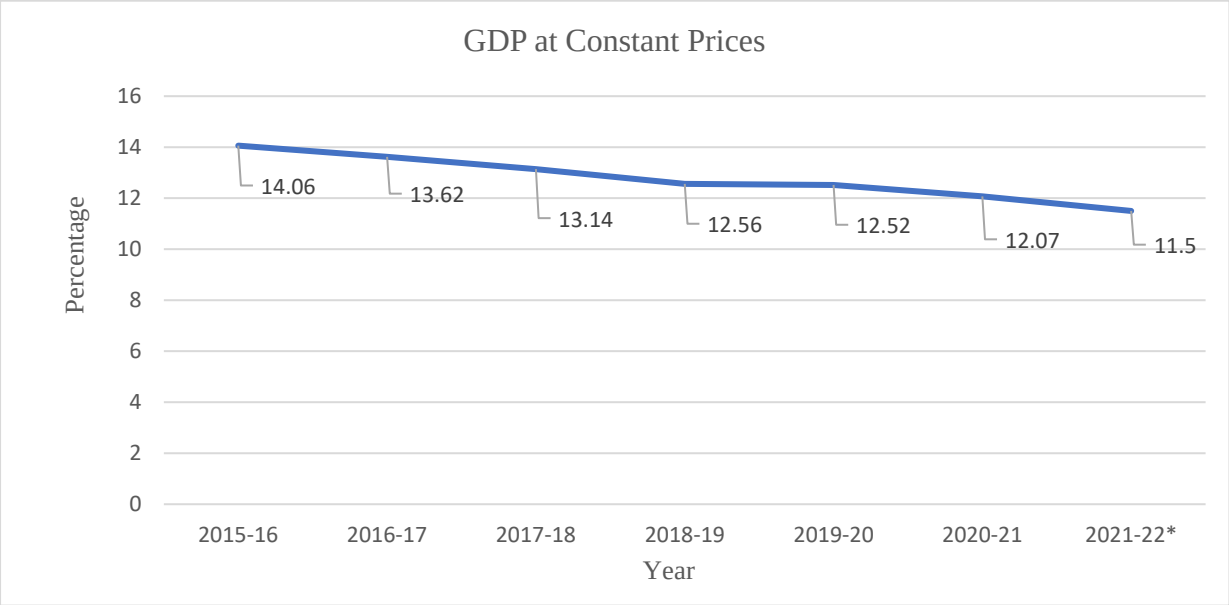


Figure 1.1: Contributions of Agriculture Sector to the Country`s GDP at Constant Price

Source: BBS, 2021

On the other side, at current prices, we can examine the sectoral share of GDP is progressively rising. It increased from 2,49,505 crore taka to 4,39,834 crore taka between fiscal years 2017-18 and 2021-22 (BBS,2021). Figure 1.2 at current prices depicts the increasing trend of agriculture's proportion of GDP (Base Year: 2015-16).

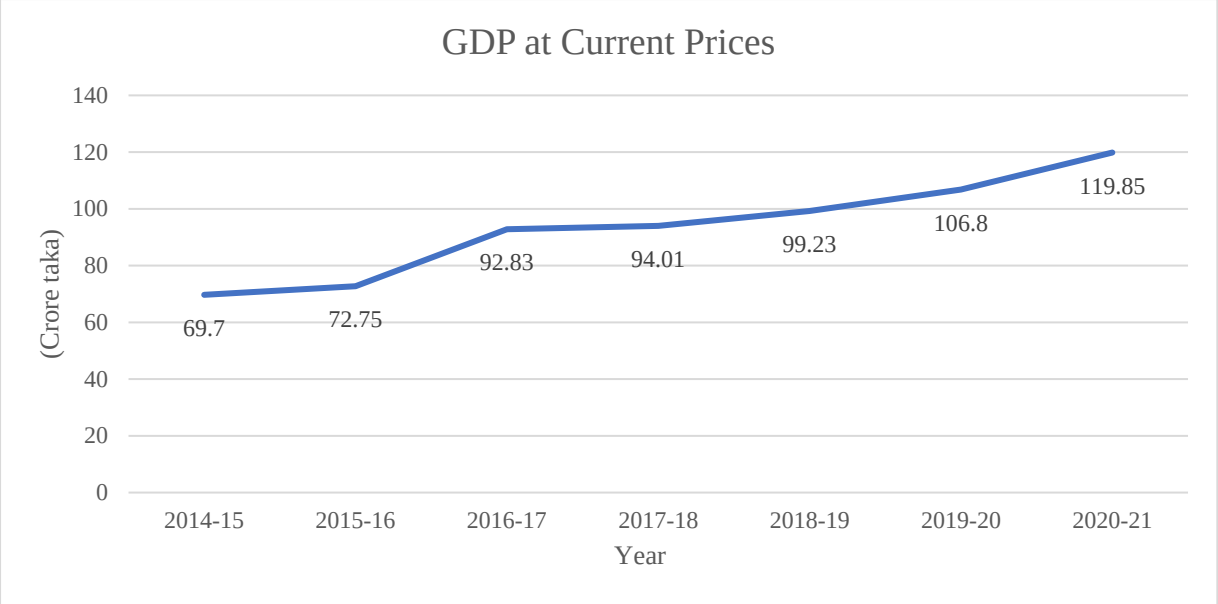


Figure 1.2: Contributions of the Agriculture Sector to the Country`s GDP at the Current Price

Source: BBS, 2021

According to the Population & Housing Census (2022), Bangladesh's population increased from 144.04 million to 165.15 million from the year 2011 to year 2022. Our economy is centered on the agricultural sector, which reduces poverty and ensures food security. The sector has however resilient in terms of profitability and productivity despite the ever-increasing population also included the effects of pandemics and climate change. Farmers' primary focus used to be on the crop sector but in recent years livestock, fishery, and forestry have emerged as important economic sectors. Sectoral growth rate of GDP at constant price (base year 2015-16) is shown in Table 1.1.

Table 1.1: Sectoral Growth Rate of GDP at Constant Prices (Base Year: 2015-16)

	2016-17	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
Growth%						
Crop & horticulture	2.22	2.75	2.07	2.5	2.29	1.06
Animal farming	2.77	2.90	3.01	3.19	2.94	3.10
Forest and related service	5.00	5.08	5.13	5.34	4.98	5.08
Fisheries	4.73	4.93	4.99	4.4	4.11	2.08

Source: BER, 2022

Growth rate of animal farming was 2.77 percent in 2016-2017 which increased by 3.10 percent in 2021-2022 (BER,2022) (Figure 1.3).

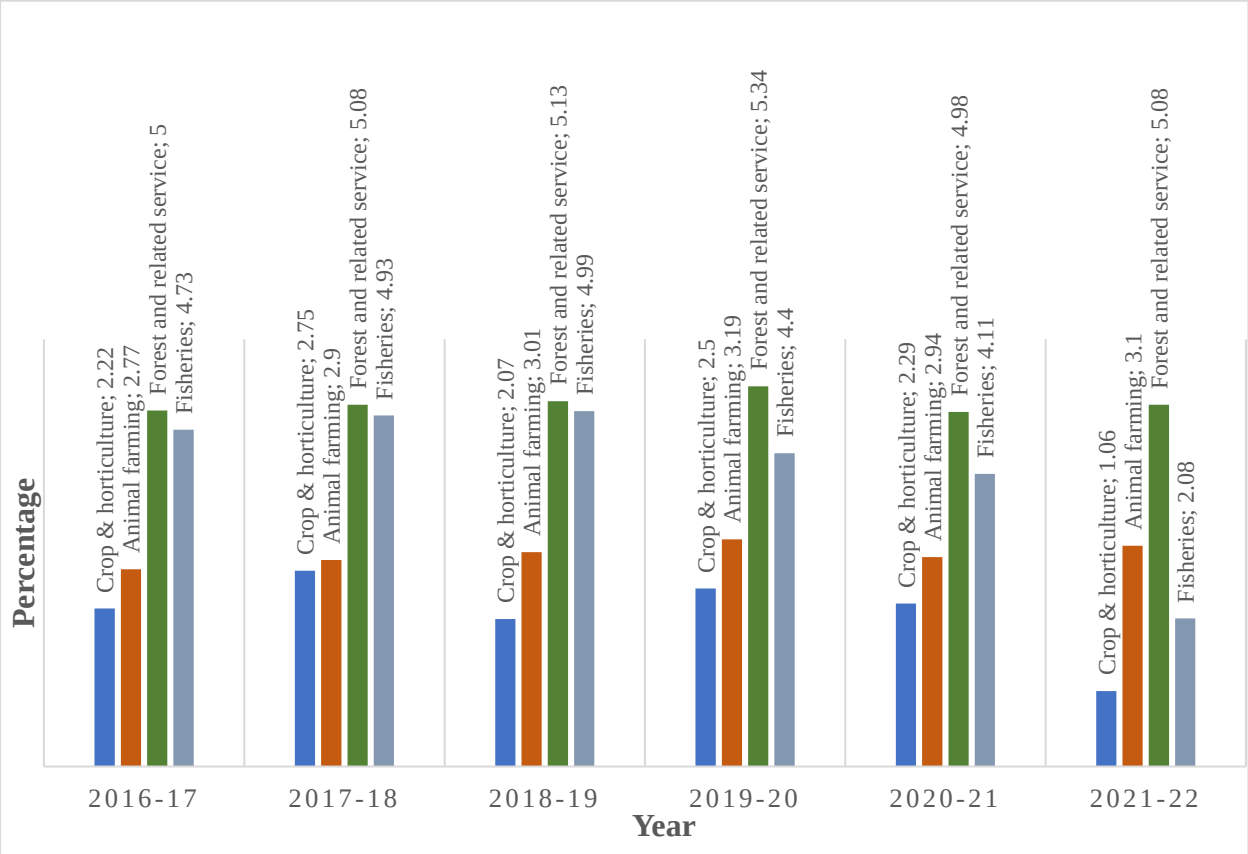


Figure 1.3: Growth rate of agriculture's subsectors

Source: BER, 2022

The GDP (gross domestic product) is significantly impacted by every subsector of agriculture. In 2021-2022, Crops and Horticulture, Animal Farming, Forest and Related Services and Fishing contribution on agricultural GDP is TK 2,11,886 Crore, TK 67,189 Crore, TK 62,577 Crore and TK 98,182 Crore respectively at current market prices. In Figure 1.4 displays the value addition to the agricultural GDP by sectors at the current market price base year (2015-2016). (BER 2022).

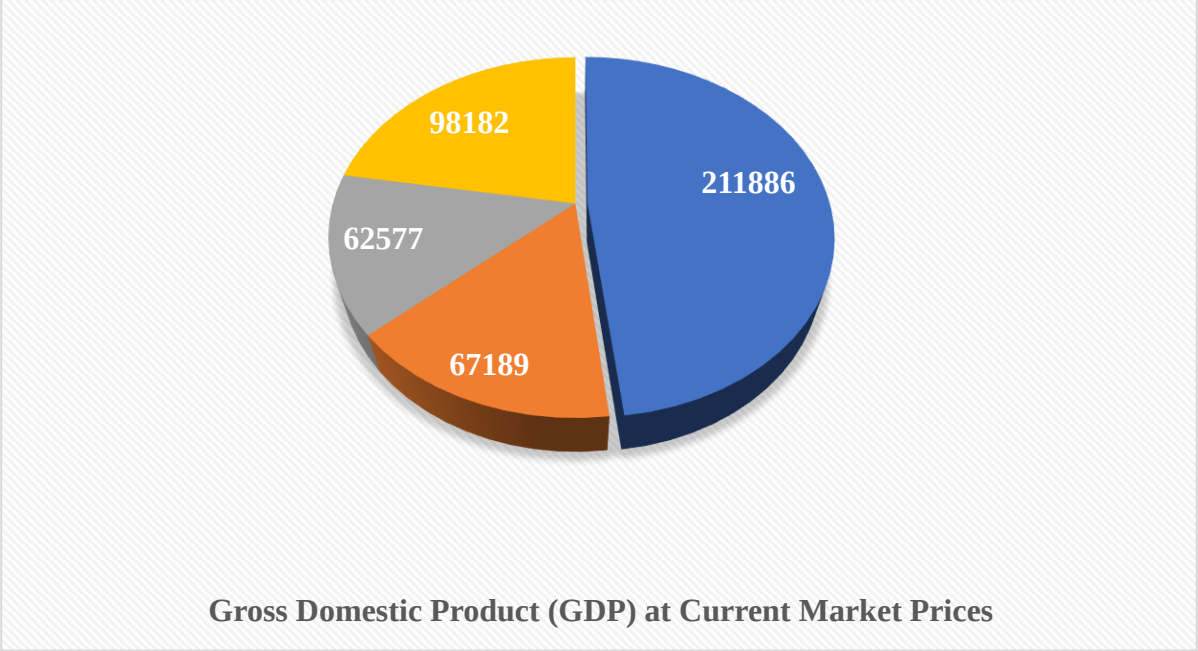


Figure 1.4: Sub-sector's GDP Percentage on Agricultural Sector at Current Market Prices 2021-2022 (Base: 2015-16)

Source: BER, 2022

1.2 Livestock Sector in Bangladesh

Livestock is considered to be a very vital component in the development of Bangladesh's rural economy. It has been contributing significantly to our economy. It can resolve all issues like malnutrition, unemployment, women's empowerment, increased agricultural land fertility, developing a skilled workforce, and generating foreign exchange etc. To meet our daily needs for food of animal origin, milk, eggs, and meat are essentials come from livestock.

In Bangladesh, the livestock sector is one of the fastest-growing sectors. Since the eighties, the livestock sector has contributed daily and has surprisingly increased employment opportunities, the number of commercial farms, and livestock production. BER (2022) asserts that the livestock industry unquestionably contributes to Bangladesh's economic expansion, food and nutrition security, the creation of self-employment opportunities, and—above all—the reduction of poverty. With the continuous efforts of the government, Bangladesh has achieved self-sufficiency in meat and egg production and has made promising progress in milk production. At constant prices, the contribution of livestock sector to the GDP in FY 2021-22 is 1.90 percent and the contribution of livestock to the overall agricultural sector is 16.52 percent. This subsector plays a crucial role in providing the body's daily need for animal

protein, which is essential to human health. The government has already taken a multi-pronged approach to livestock development. Notable examples include the growth of artificial insemination using semen generated for breed development, the manufacturing and distribution of vaccinations to prevent disease, the provision of medical care and diagnostics for animals, the training of farmers and the transfer of technology, the development of entrepreneurship, and so on. In FY 2020–21, there were 563.30 lakh livestock in the nation. (BER 2022). The country's livestock population has been steadily growing over the last few years, as Table 1.2 indicates.

Table 1.2: Livestock Population of Bangladesh (number in lakh)

Livestock	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Cattle	234.88	236.36	237.85	239.35	240.86	242.38	243.91	245.50
Buffalo	14.57	14.64	14.71	14.78	14.85	14.92	14.93	15.01
Goat	254.39	256.02	257.66	259.31	261.00	162.67	264.35	266.00
Sheep	32.06	32.70	33.35	34.01	34.68	35.37	36.07	36.08
Total livestock	535.90	539.72	543.57	647.45	551.39	555.34	559.26	563.30

Source: BER, 2022

The livestock industry's share of the agricultural sector is 16.52 percent at constant price, and its share of the GDP in FY 2021–2022 is 1.90 percent. Table 1.3 shows livestock's GDP contribution at constant prices.

Table 1.3: Livestock Contribution to GDP at Constant Price

Item (Base year:2015-16)	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
GDP (%)	2.17	2.07	2.06	1.98	1.90
Growth rate of GDP (%)	2.90	3.01	3.19	2.94	3.10
Share of Livestock in Agricultural GDP (%)	16.51	16.48	14.45	16.40	16.52

Source: BER, 2022

Table 1.4 demonstrates the share of livestock in Bangladesh's national GDP in 2021–2022.

Table 1.4: Contribution of Livestock to the National Economy of Bangladesh (2021-22)

Contribution of Livestock in Gross Domestic Product (GDP) (Constant Prices)	1.90%
GDP growth rate of Livestock (Constant Prices)	3.10%
Share of Livestock in Agricultural GDP (Constant prices)	16.52 %
GDP volume (Current prices) (Crore Taka)	67,189
Employment (Directly)	20%
Employment (Partly)	50%

Source: BER, 2022

For Bangladesh's agro-based economy to flourish, the livestock subsector plays a critical role. In terms of the GDP, livestock contribute 1.90 percent in 2022, which is 16.52 percent when considering the agricultural share. Livestock sources offer approximately 44 percent of the animal protein. In addition, exports of leather and leather goods account for 4.31 percent of overall exports. Along with mechanical tillage livestock still accounts for 30% of the overall tillage. Also, the livestock industry directly employs 20% of the population and partially employs 50% of the population. In the most recent fiscal year, the subsector had growth at a rate of 3.10 percent (BER, 2022).

The reduction of poverty, gender equity, and women's empowerment are among the seventeen goals of the Sustainable Development Goals (SDG). To attain its objectives, the government of Bangladesh has recognized livestock as a crucial component of the poverty reduction strategy in order. The government has set strategic targets for meeting protein demand, employment generation, up-scaling export earnings and women’s empowerment through the livestock sub-sector. Since it makes foreign exchange, encourages women, improves the fertility of agricultural land, and generates self-employment opportunities, livestock is one of Bangladesh's most rapidly expanding industries and a vital component to the country's food security, balanced nutrition, and resolving the problem of unemployment by establishing self-employment.

Over the past few years, there has been an increase in the production of animal proteins such as eggs, meat (chicken, mutton, and beef) and milk. Production of meat, milk, and eggs was five lakh metric tons, ten lakh metric tons, and 150 crores in 1971–1972. In the fiscal year

2021–2022, this number increased to 92.65 lakh metric tons of meat, 130.75 lakh metric tons of milk, and 2335.35 crores of eggs. Table 1.4 provides an overview of the milk, meat, and egg production statistics from FY 2012–2013 to FY 2021–2022.

Table 1.5: Production of Milk, Meat and Eggs

Products	Unit	Fiscal Year									
		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Milk	Lakh Metric Ton	50.70	60.92	69.70	72.75	92.83	94.01	99.23	106.80	119.85	130.75
Meat	Lakh Metric Ton	36.20	45.21	58.60	64.52	71.54	72.06	75.14	76.74	84.40	92.65
Egg	Crore number	761.74	1016.80	1099.52	1191.24	1493.31	1552.00	1711.00	1736.00	2057.64	2335.35

Source: BER, 2022

Particularly, as can be seen from table 1.5, milk production is consistently rising. Milk output was 50.70 lakh metric tons in FY 2012–13 and reached 130.74 lakh metric tons in FY 2021–2022. Figure 1.5 shows the increasing production from 2012 to 2022.

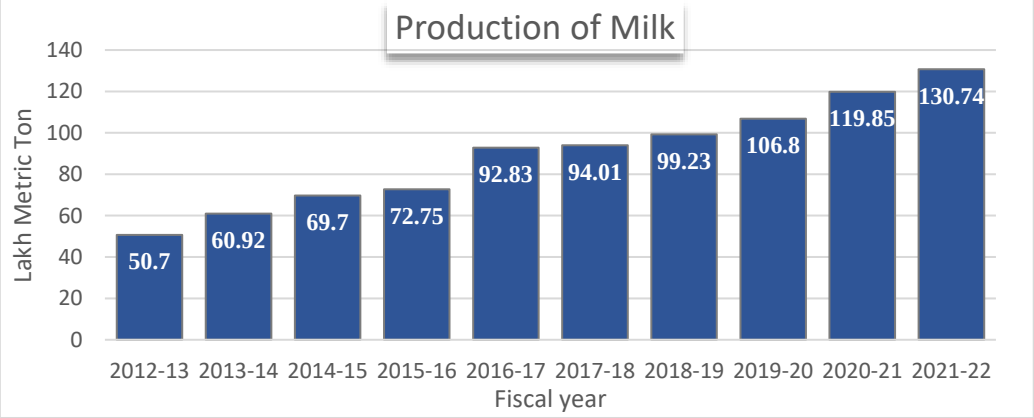


Figure 1.5: Production of Milk from FY 2012-13 to FY 2021-22

Source: BER, 2022

As a consequence, in FY 2021–2022, the per capita availability of milk, meat, and eggs increased to 208.61 ml/day, 147.84 gm/day, and 136.01 no's/year The total demand for the 2020–2021 fiscal year is 154.94 lakh mt, while the amount produced is 119.85 lakh mt. The availability per person is 193.38 ml per day. This means that the nation's production has grown by 13.05 lakh MT. Table 1.5 displays the supply, demand, and availability of milk, beef, and eggs during the fiscal year 2021–2022.

Table 1.6: Demand, Production and Availability of Milk, Meat and Eggs (2021-22)

Name of the Products	Demand	Production	Availability
Milk	156.68 Lakh Metric Ton (250 ml/day/head)	130.75 Lakh Metric Ton	208.61 (ml/day/head)
Meat	75.20 Lakh Metric Ton (120 gm/day/head)	92.65 Lakh Metric Ton	147.84 (gm/day/head)
Egg	1785.68 Crore number (104 number/year/head)	2335.35 Crore numbers	136.01 (number/year/head)
# The estimated population of the country on July, 2021: 17 Crore 17 Lakhs			

Source: BER, 2022

1.3 Milk's Nutritional and Restorative Value

Milk is often recognized as the optimum human food. Specifically for promoting infant growth, fetal development in expectant mothers, and milk supply during breastfeeding. It is considered to be nature's most perfect food and a complete diet for an infant or animals. Milk's nutritional value is quite complicated. It contains essentially every vitamin that your body requires. Its major element, which gives energy and materials for construction young people.

Biochemical Potential in a cup (249 grams) of whole cow's milk containing 3.25% fat, 152 calories, 88% Water, 8.14 g protein, 12 g carbs, 12 g sugar, 0 g Fiber, 8 g of fat, 276 mg of calcium, 322 mg of potassium, 105 mg of sodium, and 24 mg of cholesterol. (Richter et al. March, 2018). Consuming dairy products and milk may help people avoid osteoporosis and bone fractures, as well as maintain an appropriate body weight. Many people have trouble digesting milk or desire to avoid it for personal reasons. Drinking high-quality milk and other dairy products has been demonstrated to provide a range of health benefits for those who can tolerate it.

1.4 Production of Cow Milk in the Asia-Pacific Region in 2020, by Country

The biggest dairy markets in the Asia Pacific region include China, India, Pakistan, and New Zealand. India's total cow milk production was valued at around 36.8 billion US dollars in 2020, which was the highest in the Asia-Pacific region, followed by China at approximately 18.7 billion US dollars. Furthermore, the value of whole cow milk production in New Zealand, Pakistan, and Japan in that year exceeded USD 6 billion. The value of cow milk production in

Bangladesh is 0.201 billion US dollars. (S. Ganbold, 18 July 2022) Bangladesh's milk production is quite poor when compared to other Asian countries.

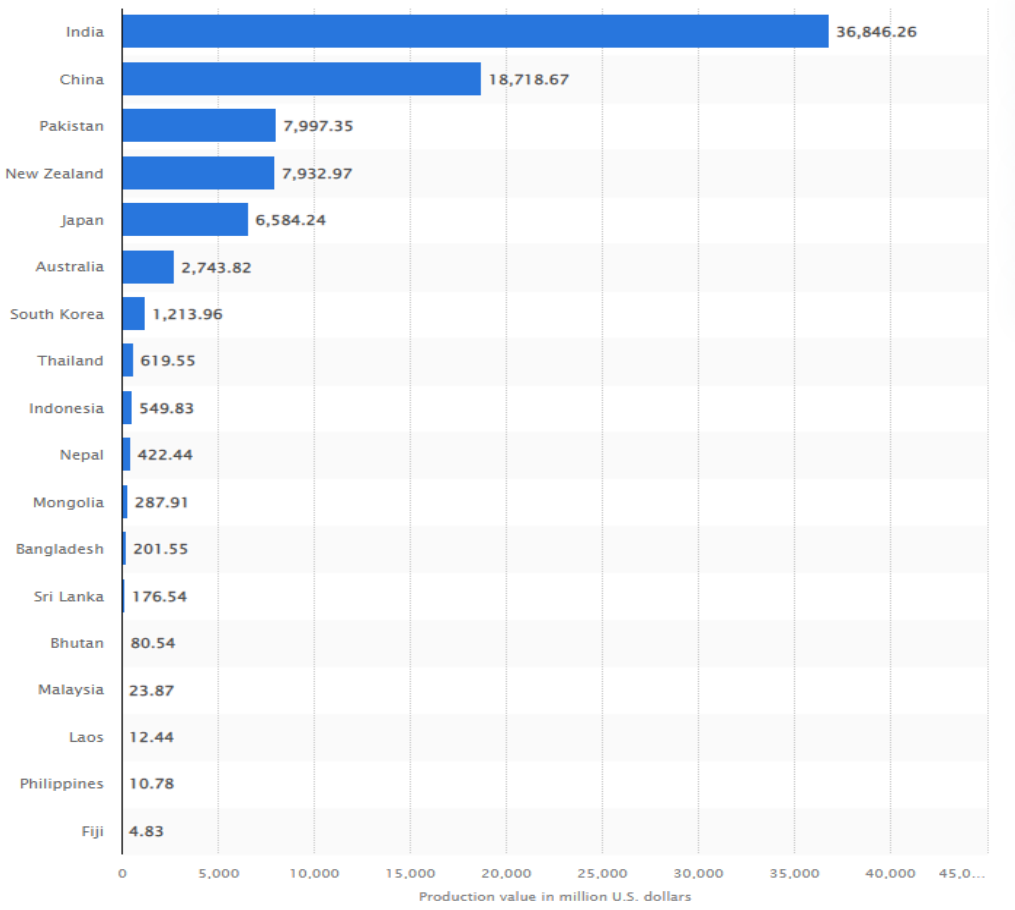


Figure 1.6: Production of Milk in the Asia-Pacific Region in 2020, by Country

Source: S. Ganbold, Jul 18, 2022

Bangladesh's dairy industry is growing very slowly but has the opportunity to meet the local demand for dairy products and has great export potential. Beyond only producing food directly, livestock rearing contributes to capital accumulation and multifunctional applications like fiber, fuel, fertilizer, and skins. A major economic challenge for any country, whether developing or developed, is creating employment opportunities for its citizens. Bangladesh is a country of about 169.4 million people (World Bank, 2021). Creating employment opportunities for employable and qualified people is the main task of the government. Economic growth will be boosted by the use of these laborers and investments in Bangladesh's diverse and modern dairy sector. Malnutrition, women's emancipation, increased agricultural land fertility, creating a talented country, and generating foreign exchange are all issues that it

can resolve. Additionally, many million resource-poor farmers depend heavily on their livestock for varied degrees of sustainable farming and economic stability. As such, livestock ownership plays an essential part in their social and cultural life. Thus, we may conclude that Bangladesh's cattle industry has a lot of potential. This research aims to investigate the productivity and technological efficiency of dairy farming in certain regions of Bangladesh's Dhaka district.

1.5 Justification of the Study

Bangladesh's overall economic growth is primarily dependent on the expansion of the agriculture sector. The majority of people living in rural areas work in various farming operations. In Bangladesh, dairy farming is a significant and promising agricultural sector. The industry where monthly income is guaranteed is dairy farming. Milk is commonly consumed by humans and is a good source of nutrients. Approximately 24.5 million cattle, 1.50 million buffaloes, 26.6 million goats, and 3.6 million sheep are found in Bangladesh (2020–21). The county's livestock industry contributes 1.90% of its GDP to the national economy. 16.5% of the agricultural GDP comes from livestock, livestock provide 20% of direct employment, and 50% of partial employment (BBS 2021). Milk output is 130.75 lakh metric tons, but demand is 156.68 lakh metric tons (250 ml/day/head). Increased milk production is required to fill the gap between supply and demand. Before focusing on milk production, it is necessary to have sufficient and pertinent information on numerous aspects of farm-level operations. Farmers must choose enterprises with limited resources, so they need to have this production knowledge to make the right choices. By improving the technical efficiency of milk production utilizing current techniques, milk production can be enhanced.

Alam et al. (2022), Datta et al. (2019) and Nripoti (2018), the researchers found that dairy farming is a profitable enterprise. Regarding the areas chosen by the author, there was no research on the technical efficiency and productivity, or the variables influencing the technical efficiency of milk producers. Consequently, the current study focuses at how different socioeconomic factors affect milk production productivity and estimates the technical efficiency of farmers who produce milk. Future livestock development strategies adopted by government officials, research managers, non-governmental organizations, and extension professionals would assist farmers by increasing livestock production, increasing income, and

creating opportunities for self-employment. Therefore, more research was required to assist policymakers in reaching the proper decisions and developing suitable policies.

1.6 Objectives of the Study

Measuring the productivity and technological efficiency of dairy production was the study's main objective. Nonetheless, the study took into account a few particular goals in order to fulfill the overall goals. They are,

- Investigating the sociodemographic characteristics of dairy producers.
- To estimate the productivity of milk production.
- To explore the technical efficiency of dairy farms.
- To list the issues that dairy producers deal with and offer legislative solutions for these issues.

1.7 Organization of the Study

There are eleven chapters in all in this thesis, and they are arranged as follows: The study's introduction is presented in Chapter 1. Chapter 2 contains the literature review. Chapter 3 discusses the relevant study's methodology. In chapter 4, the research area is briefly described. The sociodemographic profile of dairy farmers is presented in Chapter 5. Chapter 6 presents the technological efficiency and productivity of dairy farmers. The results of the dairy farming constraints are presented in Chapter 7. Chapter 8 concludes with a summary, conclusions, and suggestions for raising Bangladesh's milk productivity.

1.8 Concluding Remark

This study will provide an important insight for the concerned authority and help to boost dairy production however, the review of literature is presented in next Chapter 2.

CHAPTER 2

REVIEW OF LITERATURE

The main purpose of this chapter is to review some related studies which connected with the present study. Only a few studies have so far conducted related to productivity and technical efficiency of dairy farming. Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study. Review of some research works relevant to the present studies, which have been conducted in the recent past, are discussed below.

Adane et al. (2016) investigated Ethiopian smallholder farmers' technical inefficiency in Milk Production. Using a stochastic frontier production function approach, this research estimates the technical inefficiency in the milk output of smallholder dairy farmers in the Ethiopian highlands and finds factors related to the observed inefficiency. This cross-section data gathered from 1277 farms is used in the analysis. The conclusion shows that the mean technical efficiency for milk production is just 55%, which implies significant technical inefficiency. The findings also demonstrate that the primary determinants of technical efficiency in dairy production are household wealth, educational attainment, and accessibility to institutions and markets. Education and total household wealth were found to have a negative impact on dairy farmers' inefficiency, but the inefficiency of dairy farmers was found to be unaffected by gender of the household, age of the household, age square, and walking distance to the development agency.

Alam et al. (2022) examined the dairy milk industry's profitability and productivity in the Dhaka region. The production of dairy milk is positively impacted by significant coefficients of variables. Based on data from 70 respondents, the net return was Tk 594 and the gross return was Tk 1099, relative to the total cost of production of Tk 487.83 per cow per day. Each cow produced 12.5 liters of milk on average. The calculated Benefit Cost Ratio (BCR) was 2.17, indicating that a taka investment in the production of dairy milk will provide a Tk. 2.17 return, indicating that dairy farming is a profitable enterprise in the designated Dhaka region.

Bardhan et al. (2013) investigated the technical efficiency of milk production in India's Uttarakhand's Kumaon division under developing agricultural environment. Six randomly chosen villages in the division's plain and hilly zones provided the 60 farm households that made up the study's final sample units. These households represented different herd-size categories. To calculate the technological efficiency in milk production, a stochastic frontier production function analysis was employed. The technical efficiency measure was used to fit multivariate regression equations. It was interesting to note that smallholder milk producers were more technically adept at producing milk than their larger counterparts, particularly on the plains. This offers concrete evidence that dairy farms' production efficiency would benefit from a higher degree of commercialization. The mean technical efficiency was found to be 91% for the sample homes in the plains and 89% for the sample families in the hills. Efficiency in the plains is found to be positively affected by higher levels of commercialization and smaller herd sizes, while efficiency in the hills is positively impacted by younger family heads. Hence, to maximize the potential of existing technologies, policymakers should focus on households with elder family members in the hills and higher herd sizes in the plains in order to boost technical efficiency. Additionally, a robust and effective connection between farms and the market would motivate farmers to boost productivity, which would save a substantial amount of money, especially on the plains.

Bruhn et al. (2017) evaluated various technical and economic indices that determine the land-use change, ML, LUC, and RENT, as well as the relationships between net margin (ML), profitability (LUC), and return (RENT) of milk production systems. In the Brazilian state of Rio de Janeiro, they estimate and examine the property-size, zootechnical, and economic indices of 20 milk production systems in 2011. Along with performing a multiple linear regression analysis between the estimated indices (independent variables) and the dependent variables net margin, profitability, and return, we also perform a descriptive analysis of the variables under investigation. With SPSS 20.0, the statistical analyses were carried out. The factors that affected net margin the most were labor-intensive milk production, overall revenue, commercial concentrates for energy and protein, and the labor-to-total operating cost ratio. Then, milk revenue, fixed value by lactation matrix (value immobilized in the activity divided by the number of lactating matrices), animal productivity per day, and the representativeness of energy concentrates were the factors that had the biggest effects on profitability. In addition to animal productivity per day and the value of land assets per hectare, the number of males

available for sale had the greatest impact on economic returns. These results demonstrate that in order to lower production costs, management and technological efforts are needed. In addition, animal productivity needs to be increased because it is having the highest positive relationship with profitability.

Datta et al. (2019) performed an economic analysis of Bangladeshi dairy farming using primary data obtained through survey questionnaires given to small dairies. To examine the milk productivity and gross profit of dairy farms, multiple regression models and the Cobb-Douglas production function were estimated. The average milk productivity per cow was 7.80 liters per day; the productivity of milk from indigenous cows was 1.9 liters per day, and the productivity of milk from crossbred cows was 6.48 liters per day. A statistically significant positive correlation was found between farm size and both milk productivity and total profit, as indicated by the results of both the t-test and quantitative estimation. The study's findings also demonstrate that, in comparison to native cows, crossbred cows provide dairy farmers with sizable financial advantages.

Demircan et al. (2010) evaluate Turkish dairy farms' technical performance in comparison to findings from previous research on the production of dairy farms in developing nations. The 132 dairy farmers in the Burdur province of Turkey are producing with poor levels of technological efficiency, as per to this survey. Technical efficiency, as determined by Data Envelopment Analysis, varies from 28.6 to 100.0%, with an average of 64.2%. The two most inefficient inputs are labor and pasture feed. A statistically significant positive correlation between herd size and efficiency highlights the importance of having a larger herd size in order to fully benefit from scale economics. Additionally, there is no statistically significant correlation between the level of farm production efficiency and interaction with extension in this study.

Fariha et al. (2020) studied technical efficiency of dairy farm in the south-west region of Bangladesh and find that average milk production cost of 70 dairy farms is Tk 93886 and average milk production income is Taka 95832, which means the profit figure of this sector is low. This is due to the low price of milk and the high price of feed. Three variables are statistically significant in the production function among the seven variables. Dairy farms have

an average technical efficiency of 68%, indicating that there is wide variation in technical efficiency among farmers and that it is possible to increase dairy production. When people are educated, they use inputs more efficiently and produce more output so education is necessary for everyone, and in order to get the right education, they need to attend various training programs. The government should provide various facilities for the milk sector and ensure the availability of medicines and treatment facilities.

Garcia et al. (2004) examined the economics of dairy farming in Bangladesh and the potential for increasing the dairy income for small-scale farmers, who presently constitute the backbone of the dairy business, with a focus on small-scale producers. Few of the more than 7.2 million Bangladeshi families that produce cattle on a local scale are profitable.

Khan et al. (2012) carried out a feeding approach to increase the productivity of dairy cattle on Bangladeshi small-holder farms. A vital and integral component of smallholder subsistence farming is dairy production. Low productivity in dairy production is prevalent in our nation, primarily as a result of dietary and genetic limitations. These animals might not be able to completely exhibit their potential genetic superiority until feeding management is addressed. Providing dairy cattle with high-quality feeds in adequate quantities to optimize production is a vital strategy. Women who grow dairy products earn a consistent daily income. The safety of the family and the security of the home depend on this. The performance of milking animals is impacted by feed shortages, both in terms of quantity and quality. Local cows yield 1.5 liters of milk on average per day, whereas crossbred cows yield 5 to 8 liters per day and demand higher quality feed, primarily concentrates, which is out of reach for farmers. Crossbred cattle, however, can boost a farmer's income up to double (Tk.58 vs. 115). Future development initiatives will heavily include increasing feed production's self-sufficiency, since feed prices are now the most significant component in animal productivity.

Nripoti (2018) investigates the financial viability and business potential of the district of Dinajpur's dairy milk industry. In this thesis, random sampling was used to determine whether or not dairy milk manufacturing is a viable endeavor. The daily cost of production for each cow was Tk. 217.62. Each cow received a gross return of Tk. 567 and a net return of Tk. 318.27

per day. A total of 9.5 liters of milk were produced on average. The cost of human labor was Tk 23.15. According to the anticipated Benefit Cost Ratio (BCR) of 2.28, a taka investment in the production of dairy milk would yield Tk. 2.28.

Perez-Quesada et al. (2018) investigate technical efficiency measurement in Uruguayan dairy farms. This paper estimates a Cobb-Douglas stochastic production frontier and technical inefficiency model for dairy farms using a cross-sectional database. It does this by identifying the main elements that explain variations in farm efficiency and the impact of each input on the production frontier. Production is mostly determined by the quantity of milking cows, next by feed, pasture, and labor. Based on the empirical findings, the average technical efficiency of Uruguayan dairy farms is 74%. This implies that with the existing level of inputs and production technology, dairy farmers may increase milk production by 26%. The primary causes of inefficiencies are farmers' specialization in dairy farming and their use of artificial insemination.

Quddus (2010) conducted a questionnaire-based interview with 280 cattle producers to determine the elements that influence dairy income and labor utilization. They also compared the performance of crossbred and indigenous cows and found limits in small-scale dairy farming. The effects of socioeconomic determinants on milk revenue and inputs were assessed using multiple regression models, and the input-output linkages of milk production were investigated using the Cobb-Douglas production function. Between total income and milk income, a significantly significant positive connection ($r = 0.465$) was discovered. Because there was more food available and consumed during the rainy season, the highest milk output was seen. In the rural area, crossbred cows were mostly raised commercially through the use of hired labor. The amount of time spent dairy farming was positively and significantly impacted by both farming experience and the number of economically engaged individuals. Since concentrate has the greatest impact on milk production, farmers may be able to boost milk yield by feeding their dairy cows more concentrate. In an effort to boost milk output, new feed mills should be built by both public and private enterprises. These mills should offer high-quality feed concentrates at competitive costs, implement feed marketing regulations, and encourage farmers to use concentrates for their cows.

Rusielik et al. (2010) examined the milk production's technical efficiency in a chosen sample of European farms. The study calculates dairy farms' technological efficiency. The research findings indicate that the econometric models employed determine the technical efficiency indicators' level. Moreover, the computations offer a summary of the variations in efficiency among the nations in the corresponding years. The bulk of productive dairy farms are found in the Netherlands, Poland, Ireland, France, Ukraine, Spain, and Slovakia, according to the investigation's findings.

Serma et al. (2012) used the multidimensional scaling method to examine the technological efficiency of milk production in the state of Tamil Nadu. For this study, 480 dairy producers in total were chosen as the sample size. The amount of production efficiency in milk was estimated using the stochastic frontier production function. The average technical efficiency of sample farmers in the districts of Kanchipuram, Erode, Nagapattinam, and Thoothukudi, which make up the state of Tamil Nadu, was found to be between 77.4 and 85.8 percent realized, with the remaining percent being unrealized. The disparity in management styles, the accessibility of advanced technology, the availability of sufficient feed ingredients locally, and the employment of family labor in the dairy industry could all be contributing factors to this range of technical efficiency.

Sharafat, A. A. (2013) examined the technological efficacy of Jordanian dairy farms. It makes use of the stochastic production frontier (SPF) method. Technical efficacy estimates were generated for one hundred dairy farms in Jordan. According to the study's findings, the majority of Jordan's dairy farms produce milk with low technical efficiency. It was estimated that the mean technical efficiency was only 39.5%. This indicates that, with the current input levels, an average farm in the sample could raise its level of milk production by 60.5%. Enhancing farmers' access to extension services is necessary to raise agricultural productivity. Farmers should be encouraged to participate more actively in the extension process itself. The results show severe technological inefficiencies on Jordanian dairy farms, which suggests inefficient output. Technical efficiency can be further increased by giving farmers instruction, training, and orientation regarding dairy farming procedures.

Trnkova et al. (2020) calculate the technical efficiency of milk production in the EU, break it down, and examine what factors influence efficiency both temporarily and permanently between 2004 and 2017. The four-component model, which is now the most sophisticated method for technical efficiency analysis, and the multi-step estimating process expanded by technical efficiency determinants serve as the foundation for the analysis. The findings demonstrate that the overall technical efficiency is rather dense around the mean, reaching a mean value of 68%. Compared to the temporary portion, the ongoing inefficiency is a bigger concern for dairy production and varies greatly throughout European locations. The countries with the least institutional and structural rigidities include Belgium, the United Kingdom, and the Netherlands, where the most efficient conversion of inputs to outputs is accomplished. The findings indicate that the percentage of paid labor, the percentage of rented land, the degree of modernization, and the number of off-farm activities all have a favorable impact on transitory efficiency, whereas the amount of livestock subsidies has a negative impact. It is not established that economies of scale improve long-term efficiency. Specialization has a good impact on sustained efficiency, even though specialized farms are more susceptible to price shocks. As might be expected, localizing farms inside LFAs has a detrimental effect on long-term technical efficiency.

Uddin et al. (2011) Bangladesh, which has a dairy system typified by small-scale businesses integrated with crops and other off-farm activities, has been the subject of studies of milk production trends and dairy development. This study examines the consequences for South Asian nations of significant developments in the dairy industry and the definition of Bangladesh's dairy production systems. Per capita milk consumption is rising at a rate of 4% annually, outpacing the 3.6% growth in milk production. As a result, the difference between the supply and demand of milk has continued to grow. Since institutional support and policies are crucial in closing this gap, they should be taken into account when formulating development strategies for the dairy industry. Bangladesh's milk production is rising, but so is the difference between what is produced and what is consumed. Improving production and lowering imports of milk powder may be possible with the right institutional assistance and policy changes. To promote dairy development, sector-specific policies, institutional and organizational structures, and services for dairy farmers' support must be appropriately geared toward the market. The scenario of small-holder milk markets and dairy production methods demonstrates that the conventional system with unofficial market ties dominates the Bangladeshi dairy sector, with

imports of milk powder playing a major role in meeting domestic demand. To effectively expand the dairy industry, the informal sector should be supported, but it must show greater care for public health and quality issues. A sample of 132 dairy producers in Turkey's Burdur Province had their technical efficiency examined using the Data Envelopment Analysis method. With an average output rate of 65.2%, these dairy farmers were producing at a low level of efficiency when compared to earlier studies on dairy farm production in developing nations. Merely 13.5% of dairy farms were utilizing efficient input levels. Compared to forage feed and labor inputs, concentrated feed and capital were employed more effectively. On average, it is possible to lower all four of the key inputs—labor, capital, concentrated feed, and pasture feed—while keeping milk output at the same level. According to this research, extension initiatives ought to concentrate on these four inputs. Increased productivity in the dairy industry will benefit Turkish dairy farmers' bottom lines as well as the country's standing internationally. Additionally, consumers would gain from cheaper dairy product pricing.

Yilmaz et al. (2020) performed a study on the technical efficiency of milk production and used cross-sectional data from 92 sample dairy farmers in Turkey's West Mediterranean Region to examine the productivity of farmers in the dairy industry. The study measured the technical efficiency of farmers in the production of milk using the Stochastic Frontier Analysis (SFA). The dairy farm sample's technical efficiency varied from 0.30 to 1.00. The average farmer efficiency in the sample was 0.55, suggesting that there is significant room to improve farmer efficiency and bolster the region's dairy industry's competitiveness. It was determined that inefficient input utilization accounted for 97.3% of the changes, with random factors accounting for the remaining 2.7%. Household size, the total number of cattle, the ratio of the total number of dairy cows to the total number of cattle, and technological level were the most important elements influencing the efficiency of dairy production. These elements have significant policy ramifications for reducing farmers' current levels of milk production inefficiency.

Wubeneh et al. (2006) investigated the small-scale dairy farmers' technical efficacy in the central Highlands of Ethiopia. A Cobb- Douglas stochastic production function was employed to examine the inefficiencies faced by dairy farmers in the Central Highlands of Ethiopia. The average technical efficiency of the 74 dairy farmers in this study was found to be 79%. The

results show that the quantity of cross-bred cows, the price of concentrate and fodder, and the amount spent on veterinary care all have a major impact on milk production. Using currently available technology, farmers may increase milk output by 21% on average by learning about state-of-the-art management practices for feeding, calving, milking, storing, processing, and selling. The results show that milk output is not impacted by local breed cows, family labor, or paid labor; on the other hand, milk output is positively impacted by cross-breed cows, concentrate, pasture, and veterinarian expenses. It also shows that while literacy and livestock training have a negative impact on dairy farmer inefficiency, age, gender, location, and credit have no effect on it.

Specific Research Gap

To the best of my knowledge, no studies have been conducted on the productivity and technical efficiency of dairy farmers in Savar upazila in the Dhaka district. Several studies (Alam et al., 2022; Fariha et al., 2020; Khan et al., 2012) have examined the technical efficiency and productivity of dairy production in various aspects. It is important to identify the variations in the productivity and technical efficiency of dairy production since these factors affect farm production in general and dairy productivity in particular. These factors include a variety of managerial and resource restrictions. Thus, this study aims to explore the productivity and technological efficiency of Bangladeshi dairy producers in the Dhaka district. The study's findings will aid in the better understanding of the existing situations by policymakers and aid in the creation of efficient policy interventions that would hasten the development of agriculture and milk production.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Methodology is the process of figuring out how to solve a research problem in a systematic way. It's the whole research plan that outlines how the research will be done and, among other things, which techniques will be used. It's a key part of any research project. How reliable a study's findings are depends on which technique was used during the study. This chapter describes several data collection and analysis strategies that were used that are relevant to the study. Using the inappropriate methodology can cause inaccurate results. It is very important for the author to explain in detail the types of methods and procedures to consider when selecting the study areas, data sources, analyses, and interpretations to reach an appropriate result. The study's location, sampling and sample size, data types, data collection methods, data management, and so forth will all be covered by the approaches. In order to estimate the productivity and technical efficiency of dairy farming, primary data collection from specific dairy farms in specific areas of Bangladesh was used in this study. Below is a timeline of the methodology employed in this investigation.

3.2 Sampling Frame

The sampling frame for the present study was selected purposively to select the area where dairy farming was intensive. Based on higher concentration of milk production, four union parishad namely Aminbazar, Bongaon, Birulia, Savar paurashava, under Savar upazila in Dhaka district were selected for the study. The following factors were primary in choosing the study areas:

i. A large number of dairy farmers are available in these study areas.

ii. These unions had similar agro-ecological characteristics.

iii. Easy accessibility and good communication facilities in these unions.

iv. Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

v. To conduct a socioeconomic study in these study areas.

3.2.1 Sample Size

A vital component of any research project is sampling. The survey area and sample size were chosen with time and budget constraints in mind. Generally speaking, higher sample sizes translate into higher reliability, lower error, and increased confidence in the results as they represent the features of the population as a whole. To choose a representative sample size of dairy farmers, Poate and Daplyn's (1993) straightforward sample size guidelines were taken into consideration. Samples consisted of 120 dairy farmers who raised various breeds of dairy cows in the designated areas.

3.2.2 Sample Selection Procedure

Farm level data are directly obtained through interviews from each respondent for this study. Using simple random sampling, where each unit of the population has an equal chance of being selected, is the best way to prevent bias in the sample selection process (Scheaffer, 1979).

A multistage purposive technique was used to select the sample. For instance, at the first stage dairy farming dominated Upazila from Dhaka district have been selected purposively considering the convenience of data collection of the researcher. In the second step, researcher selected four Union from Savar Upazila namely Aminbazar Union, Bongaon Union, Birulia Union, Savar Paurashava Union, as the concentration of dairy producing farmers in the study areas. In the third step, researcher herself communicated with Upazila Livestock Extension Officer and Livestock service provieder with a view to selecting dairy farming concentrated villages. Thereafter, eight villages namely Hijali, Bardeshi (Amin Bazar Union), Chakulia, Gandharia (Bongaon Union), Sarulia, Bhomka (Birulia Union), Rajasan, Majidpur (Savar Paurashava Union) were selected purposely in order to collect data. Finally, 15 sample from each village have been selected by random sampling. (Table: 3.1)

Table: 3.1 Sampling Distribution

Farm	District	Upazila	Union	Village	Sample size
Dairy	Dhaka	Savar	Aminbazar	Hijali, Bardeshi	30
			Bongaon	Chakulia, Gandharia	30
			Birulia	Sarulia, Bhomka	30
			Savar Paurashava	Rajasan, Majidpur	30
Total					120

Source: Field Survey, 2022

3.3 Data Collection Procedure

Dairy farmers in the chosen areas were surveyed in the field and directly interviewed in order to gather primary data. Data collection on milk production, labor utilization, input use, natural and socioeconomic constraints, and prices were also part of the fieldwork. The approach included a field survey, an analysis of earlier research, interviews with knowledgeable dairy farmers, and the researchers' own close observation.

3.3.1 Design of Questionnaire

To gather appropriate information from respondents, a structured questionnaire was created. A draft questionnaire was created for pre-testing in order to confirm the questions' relevance and the type of response from the farmers, as the survey primarily depends on the creation of the survey schedule. Following pre-testing, the final survey schedule and questionnaire were created with the necessary corrections, modifications, and adjustments. The following heads were included in the questionnaire design used in this study.

3.3.2 Questionnaire Pattern for Dairy Farmers

A) General information of the sample farmers

B) Family composition of the sample farmers

C) Age of farmer and years of experience in farming

D) Occupational and educational status of sample farmers

E) Information about total land, farm land, pasteurized land, leased land

F) Production cost of dairy farming;

G) Amount of milk obtained and selling price of output.

H) Training and loan facility for dairy production;

I) Problem faced by the dairy farmers.

Although the questionnaires were in English, the respondents were asked questions in their native tongues.

3.3.3 Data Collection Techniques

The researcher used a structured questionnaire to gather necessary data from primary and secondary sources. The study's objectives were met through the use of surveys and interviews.

Following the scheduling of the survey, direct interviews with farmers were used to gather primary data at the field level. Before the study began, a brief explanation of its goals was given to the farmers. The confidentiality of the information they submitted was guaranteed to the respondents. The first set of data was provided by dairy farmers.

On the other hand, publications and statistical bulletins provided the secondary data. such as the Bangladesh Economic Reviews, the Statistical Yearbook of Bangladesh, books, papers, and websites of Bangladesh Bank (BB), Sher-e-Bangla Agricultural University's Master's thesis, national and international journals, articles, and publications, and the Internet.

3.4 Period of Data Collection

One can work in dairy farming all year round. The researcher, with the assistance of the local livestock service providers and livestock extension officer, gathered the data for this study between August and September of 2022.

3.5 Processing, Editing and Tabulation of Data

The research topic was intriguing and difficult. The process of gathering data was also very challenging. Kobo Toolbox is an easy-to-use, robust, and dependable software that researchers use for data collection, analysis, and management in monitoring, evaluation, and research projects. For the purpose of consistency and completeness, the gathered data were examined and validated. Once the data collection process was finished, the raw data were edited, coded, and saved as an Excel file on a computer. The data that was gathered was examined using statistical software (STATA). Microsoft Excel was used to complete the descriptive analysis, and data were presented in tabular and graphical form because these formats were widely used, easy to understand, and required little computation. In addition, functional analysis was used to get the desired results. The statistical package STATA and the relevant software, Microsoft Excel, were used to analyze the data's technical efficiency.

3.6 Analytical Techniques

To accomplish the goals of the research, data were analyzed. In this investigation, a number of analytical techniques were used. A large portion of the data analysis process involved the use of descriptive statistics. This method was employed due to its innate ability to present the true picture of the farm economy in the most straightforward manner. Arithmetic mean or average and percentage were two rather basic statistical techniques used to describe the socioeconomic traits of dairy farmers and analyze data. The current study will employ a Cobb-Douglas type stochastic frontier production function to estimate productivity and technical efficiency in a way that is consistent with the theory of production function.

3.6.1 Productivity and Technical Efficiency Analysis

Productivity is the amount of output that can be generated given a specific set of inputs. When more output is produced with the same number of inputs or when the same amount of output is produced with fewer inputs, productivity rises. Productivity might be defined as the farm's ability, at a specific level of knowledge and technology, to transform inputs into the ultimate output. While TE determines the degree of adherence to the observed production process in relation to an optimality standard, it also provides a measure of the capacity to transform the inputs. Technical efficiency is one component of productive efficiency. The ability to reduce

waste by producing as much output with a given level of inputs or by using as little input to produce a given level of output is known as the technical efficiency component. A measure of technical efficiency was first introduced by researchers Debreu (1951) and Farrel (1957) to a large audience. According to Farrel (1957), a technical efficiency measurement can be achieved by counting the number of inputs and outputs without taking their pricing into account. A firm must be technically efficient before it can be economically efficient since technical efficiency is a part of overall economic efficiency.

3.6.1.1 The Stochastic Frontier Model

The most widely recognized, logically sound, and practically trustworthy method for estimating farm productivity and efficiency is the stochastic frontier model. It is an improvement over the conventional average production function and all forms of deterministic frontiers because it incorporates a symmetric error term into the model in addition to the one-sided error component. As a result, the frontier is free to fluctuate among farms and captures the effects of measurement error, additional statistical noise, and unforeseen shocks that are outside the firm's control. One side of the effect of inefficiency with respect to the stochastic frontier is represented. Aigner, Lovell, and Schmidt (1977) originally proposed the "composite error" model, which is another term for the stochastic frontier model. It was later developed and expanded upon by Jondrow et al. (1982). The concept of a deterministic frontier that all farms share ignores the very real possibility that a farm's performance could be impacted by both controllable and totally uncontrollable factors (e.g., malfunctioning machinery, inclement weather, interruptions in the input supply chain, and so forth). Nevertheless, when estimating the model, stochastic frontiers take into account every variable, making a distinction between the random error effect and firm-specific efficiency. Because of this, the estimated parameters and the efficiency measurements are both objective.

3.6.1.2 Specification of the Stochastic Frontier Model

To estimate the degree of productivity and technical efficiency, we have defined the Cobb-Douglas Stochastic Frontier Production Function. The stochastic frontier has the following functional form:

$$Y = \beta_0 X_1 \beta_1 X_2 \beta_2 \ldots\ldots\ldots X_6 \beta_6 e^{V_i - U_i} \qquad (3.1)$$

The above function is linearized double-log form:

$$\ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i - U_i \qquad (3.2)$$

Where,

Y = Revenue (Tk/cow/year)

X_1= Hired labor cost (Tk/cow/year)

X_2= Family labor cost (Tk/cow/year)

X_3= Concentrated feed cost (Tk/cow/year)

X_4= Roughage feed cost (Tk/cow/year)

X_5= Veterinary cost (Tk/cow/year)

X_6= Utility cost (Tk/cow/year)

The model of the technical inefficiency effects in the stochastic production frontier equation is defined by

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + W_i \qquad (3.3)$$

Where, Z_1……. Z_6 are explanatory variables.

The equation can be written as:

$$U_i = \delta_0 + \delta_1 \text{Education} + \delta_2 \text{Farm experience} + \delta_3 \text{Training} + \delta_4 \text{Veterinary service} + \delta_5 \text{Agricultural credit} + \delta_6 \text{Distance to market} + W_i \qquad (3.4)$$

V is two-sided uniform random variable beyond the control of farmer having N (0, σ v2) distribution, U is one-sided technical inefficiency effect under the control of farmer having a positive half normal distribution {Ui~|N (0, σ u2) |} and W_i is two-sided uniform random variable. W is an unobservable random variable with a distribution that is positive half normal. Together, STATA and MS Excel were used to estimate the model.

Table 3.2 Definitions of Different Variables

Variable	Definitions	Expected Sign with Productivity
Hired labor cost (Tk/cow/year)	The cost of involving hired labor yearly during dairy farming. Actual overall market price is considered.	Positive (+)/Negative (-)
Family labor cost (Tk/cow/year)	The cost of involving family labor yearly during dairy farming. It is calculated on hour basis and child is consider 1.5= 1 adult.	Positive (+)/Negative (-)
Concentrated feed cost (Tk/cow/year)	The cost of feed like grain, oil cake and meal, commercial ready feed, minerals vitamins etc during dairy farming per year. Actual overall market price is considered.	Positive (+)
Roughage feed cost (Tk/cow/year)	The cost of feed like straw, green fodder etc during dairy farming per year. Actual overall market price is considered.	Positive (+)
Veterinary cost (Tk/cow/year)	The cost of treatment, vaccination, deworming etc during dairy farming per year. Actual overall market price is considered.	Positive (+)
Utility cost (Tk/cow/year)	The cost of electricity, mosquito coil, net etc during dairy farming per year. Actual overall market price is considered.	Positive (+)/Negative (-)
Education	Years of schooling of the farmers.	Positive (+)/Negative (-)
Farm experience	Years of farm experience of the farmers.	Positive (+)/Negative (-)
Training	A dummy variable that takes a value of 1 if respondents have received livestock rearing training and 0 otherwise.	Positive (+)/Negative (-)
Veterinary service	A dummy variable that takes a value of 1 if respondents have access to veterinary doctor and 0 otherwise.	Positive (+)/Negative (-)
Agricultural credit	A dummy variable that takes a value of 1 if respondents have received any agricultural credit and 0 otherwise.	Positive (+)/Negative (-)
Distance to market	Distance from home to local market in Kilometre.	Positive (+)/Negative (-)

3.7 Concluding Remark

A total of 120 dairy farmers were selected as samples. through field survey and direct interview method Primary data has been collected from dairy farmers. The secondary information was gathered from a variety of research materials, including articles, thesis papers, and other

statistical reports. Microsoft Excel was used to edit, code, and enter raw data into the computer. The descriptive evaluation was finished and presented in tabular and graphical form using STATA. We specified the Cobb-Douglas Stochastic Frontier Production Function to estimate the level of technical efficiency. Nonetheless, the following chapter presents a brief synopsis of the descriptive characteristics of the research area.

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

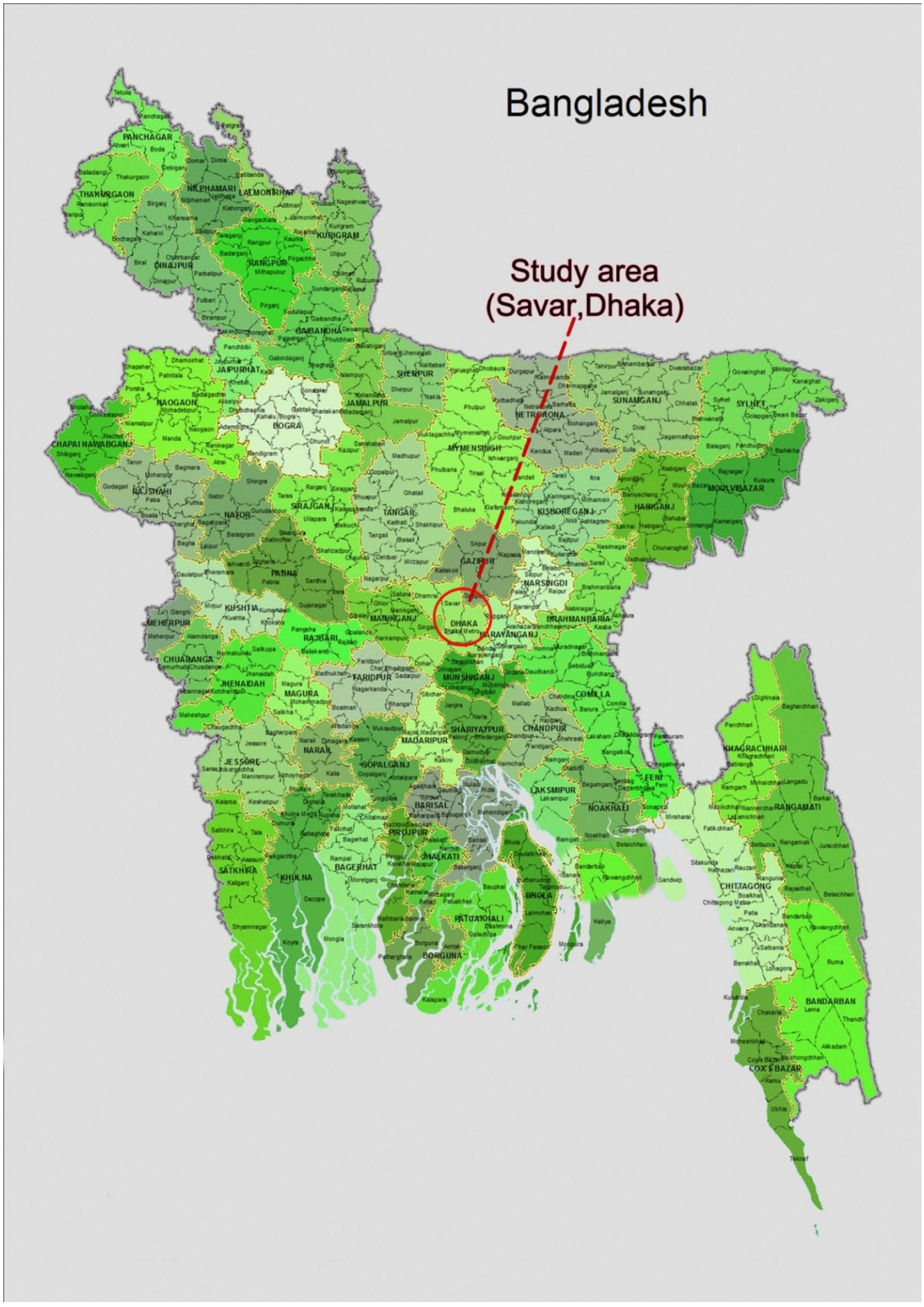
4.1 Introduction

Knowing the physical characteristics of the study area is crucial for any research because it gives an overall picture of agriculture. This chapter has provided a brief summary of the characteristics of the research area. Understanding and interpreting study results requires an understanding of the study area, as well as familiarity with the agricultural practices, potential for development, and potentials of the region. This chapter covers the study area's geography, size, population, average monthly temperature and precipitation, agriculture, occupation, and communication and marketing infrastructure.

4.2 Location

About 24 kilometers to the northwest of Dhaka city is Savar, an upazila of the Dhaka district in the division of Dhaka, Bangladesh. For this study four union parishad namely Aminbazar, Bongaon, Birulia, Savar paurashava, under Savar upazila in Dhaka district were selected.

Savar is located at 23°51′30″N 90°16′00″E / 23.8583°N 90.2667°E / 23.8583; 90.2667. It has 66,956 units of household and a total area of 280.13 square kilometers. Researcher first location was Aminbazar area 8.174 sq km located in 23.78613° north latitude 90.32934° east longitude. Turag River starting from Amin Bazar. Second location was Bongaon area 21.56 sq km located in 23.823353° north latitude 90.318897° east longitude. Third location was Birulia area 21.56 sq km located in 23.8477° north latitude 90.3351° east longitude. Final location was Savar paurashava are 14.08 sq km located in 23.858334° north latitude 90.26667° east longitude.



Map 4.1: Map of Bangladesh

Source: https://www.mapsland.com/asia/bangladesh/administrative-map-of-bangladesh

Map 4.2: Map of Dhaka District

Source: www.mapsofworld.com

4.3 Physical Features, Topography and Soil Condition

With a total area of 291.9 km2, Savar is the second-largest upazila in the Dhaka district. It is expanding quickly due to urbanization and industrialization. Geographically, it is located near Dhaka's northern boundary, between latitudes 23°44′ N and 24°12′ N and longitudes 90°11′ E and 90°22′ E. There are twelve unions in Savar Upazila; the Shimulia union has the biggest territory and Savar Pourashava has the smallest. The soil on the property is Pleistocene-era alluvium. The land gradually rises in elevation from east to west. The Bangshi and Dhalashwari rivers' alluvium soil makes up the southernmost portion of Upazila. Bangshi, Turag, Buriganga, and Karnatali are the principal rivers. Industrialization has caused pollution in the Bangshi River. There are 16,745.71 hectares (41,379.6 acres) of cultivable land overall, plus 10,551.18 hectares (26,072.5 acres) of fallow land. In Savar, manufacturing and agriculture comprise the two main economic sectors. Located here in Savar, Central Cattle Breeding and Dairy Farm is a government-owned cattle breeding farm and research center in Bangladesh.

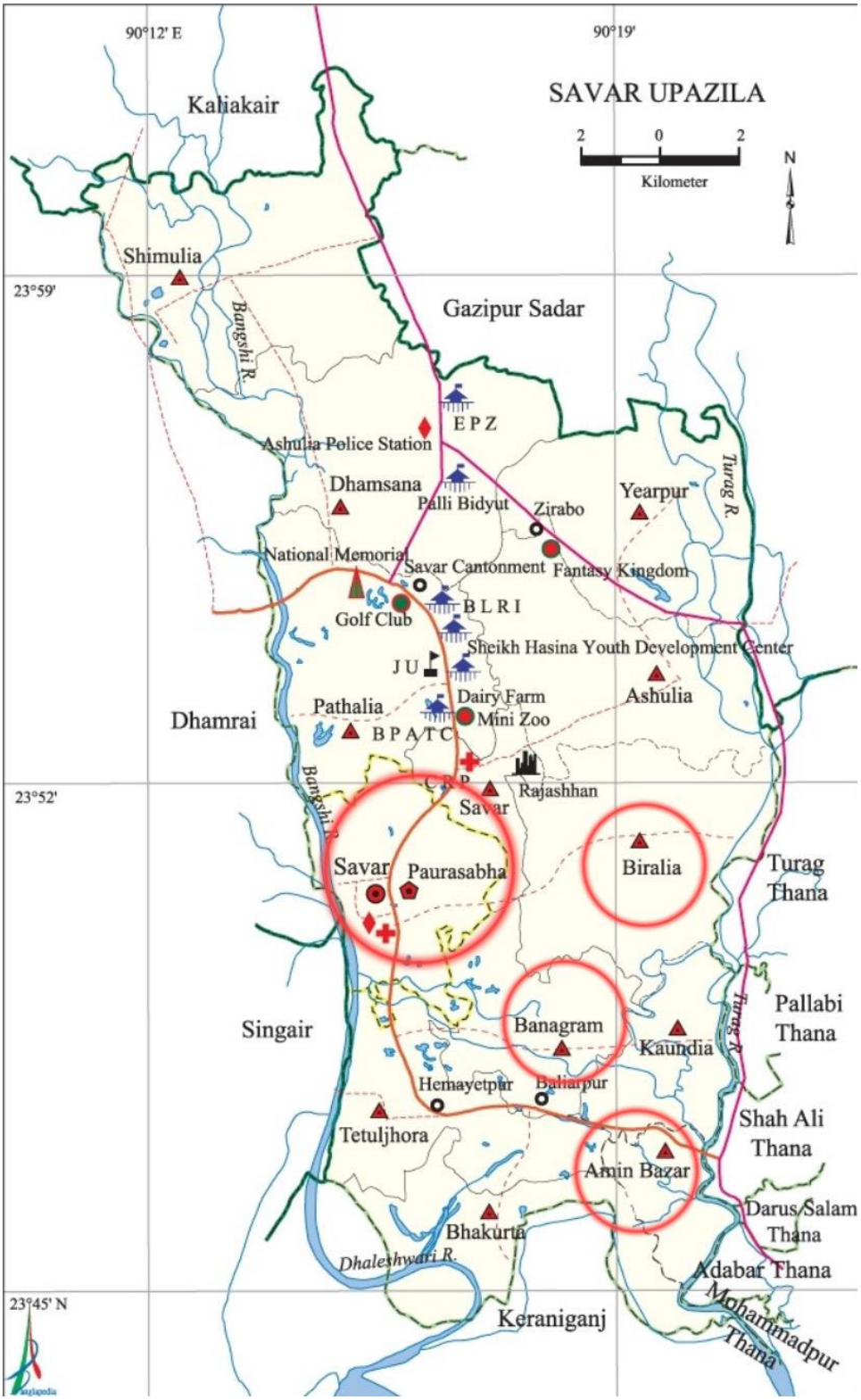
4.4 Area and Population

The area of the upazila is 291.9 km2. The total area, population and density of population of the selected upazila is presented in Table 4.1

Table 4.1: Number of Household, Population and Density, 2021

Upazila	Household	Population			Sex ratio (M/F)	Average size of household	Density per sq km
		Male	Female	Total			
Savar	66,956	738,764	647,146	1,385,910	87	20.69	4,748

Source: BBS, 2021



Map 4.2: Map of Savar Upazila

Source: Banglapedia

4.5 Climate, Temperature and Rainfall

Savar is situated at an elevation of 10.62 meters (34.84 feet) above sea level, giving it a tropical wet and dry or savanna climate. The district experiences an annual temperature of 30.11ºC (86.2ºF), which is 2.37% higher than the average for Bangladesh. Savar experiences 120.12 rainy days (32.91% of the time) and 74.11 millimeters (2.92 inches) of precipitation on average each year.

4.6 Economy

In Savar, manufacturing and agriculture comprise the two main economic sectors. Various crops, including rice, jute, peanuts, onions, garlic, chiles, and other fruits and vegetables; additionally, fisheries, poultry, fishponds, and hatcheries. There is a Bangladesh Export Processing Zone in this Upazila. Dairy products, meat, sweetmeat, jackfruit, papaya, flowers, fabrics, dye, medicines, ready-made clothing, electronics, and electric goods are among the top exports. percentage of Agriculture, Industry and Service in Savar Upazila are given in Table 4.2

Table 4.2: Agriculture, Industry and Service percentage in Savar

Agriculture %	Industry %	Service%
23.6	59.6	16.8

Source: Wikipedia

4.7 Concluding Remark

The features of the study area have been briefly summarized above. The location, area, population, monthly average temperature, rainfall, economy, and agricultural facilities of the selected area were discussed in order to achieve the study's goal. However, the following Chapter 5 provides a description of the socioeconomic features of the study area.

CHAPTER 5

SOCIO-DEMOGRAPHIC PROFILE OF DAIRY FARMERS

5.1 Introduction

Giving a general overview of the areas under study and explaining the socioeconomic characteristics of dairy farmers are the main goals of this section. Social scientists use the term "socioeconomic characteristics" to refer to a broad range of pertinent social and economic elements. Numerous social and demographic traits, such as age distribution, the ratio of different racial compositions, marital status, and more, are considered socio variables. Economic describes the state of the economy, including things like income and the unemployment rate. The socioeconomic characteristics of an individual greatly influence how they make decisions. It was not able to compile all the information about the socioeconomic characteristics of the sample farmers due to time and resource limitations. Farmers from the union Amin bazar, Birulia, Bongaon, and Savar pourashava of the Savar division were included in the current study. The farmer's age, education, experience, primary and secondary sources of income, family size, land ownership, breed type, credit availability, veterinary care, training facilities, etc. were among the socioeconomic factors taken into account in this study.

5.2 Distribution of the Respondents Based on Age

In the present study, the average age of the dairy farmers was 42.55 years. Table 5.1 displayed the minimum and maximum age of a dairy farmer in that area observed to be 25 years and 69 years respectively.

Table 5.1: Summary of Respondent's Age in Study Area

Criteria	Mean	Min	Max
Age	45.96	25	69

Source: Field survey, 2022

All factors were categorized based on their potential scores, with the exception of age, which was categorized using guidelines supplied by the People's Republic of Bangladesh's Ministry of Youth and Sports. Table 5.2 displays how the various age groups of dairy farmers in the study area were categorized.

Table 5.2: Distribution of the Respondents Based on Age in The Study Area

Category of age	Number of the Respondents	Percentae of the Respondents
Young aged (17-35 years)	17	14.17
Middle aged (36-50 years)	79	65.83
Old aged (above 50 years)	24	20

Source: Field survey, 2022

Note: Age has been categorized based on the (MoYS, 2012)

120 farmers were selected as a representative sample and according to study area 14.17 percent were under the ages of 17 and 35, 65.83 percent were under the ages of 36 and 50, and 20 percent were over the age of 50. Figure 5.1 displayed the age-based distribution of the dairy farmers.

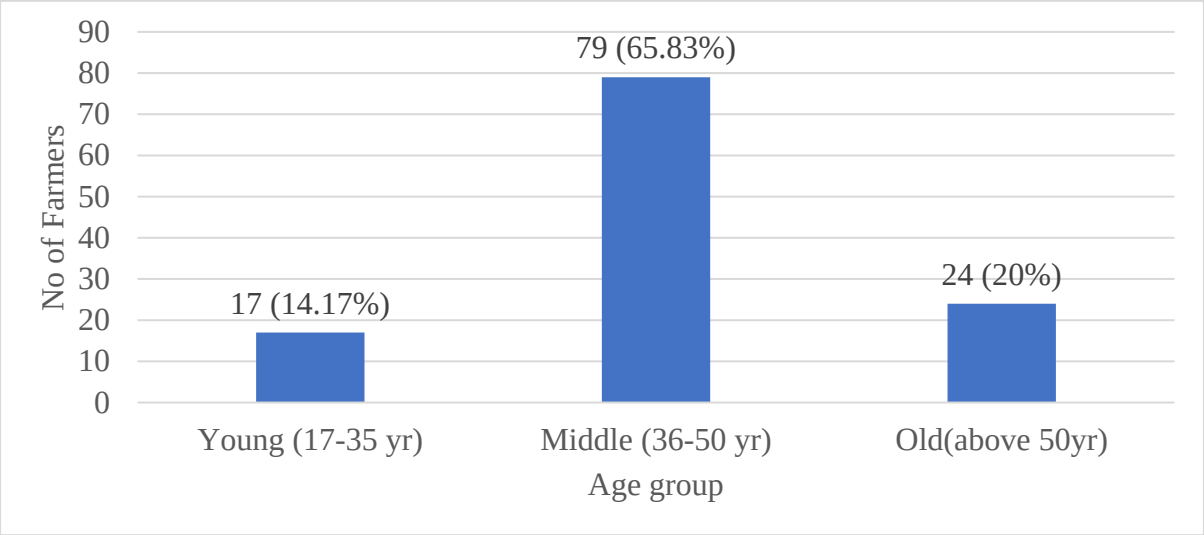


Figure 5.1: Age Group of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.3 Distribution of the Respondents Based on Educational Status

Education is a key factor in driving development and one of the most effective tools for eradicating poverty, promoting health and gender equality, peace and stability. A higher level of education can help people learn more about the food and livelihood systems. Higher education levels are also related to greater financial resources, which are again dependent on higher levels of earnings. According to Ministry of Education (2016), education in Bangladesh has three major stages. Primary stage (classes 1-5), Secondary stage with three sub-stages which is junior secondary (classes 6-8), secondary (classes 9-10), higher secondary (classes 11-12) and Higher stage (13-17).

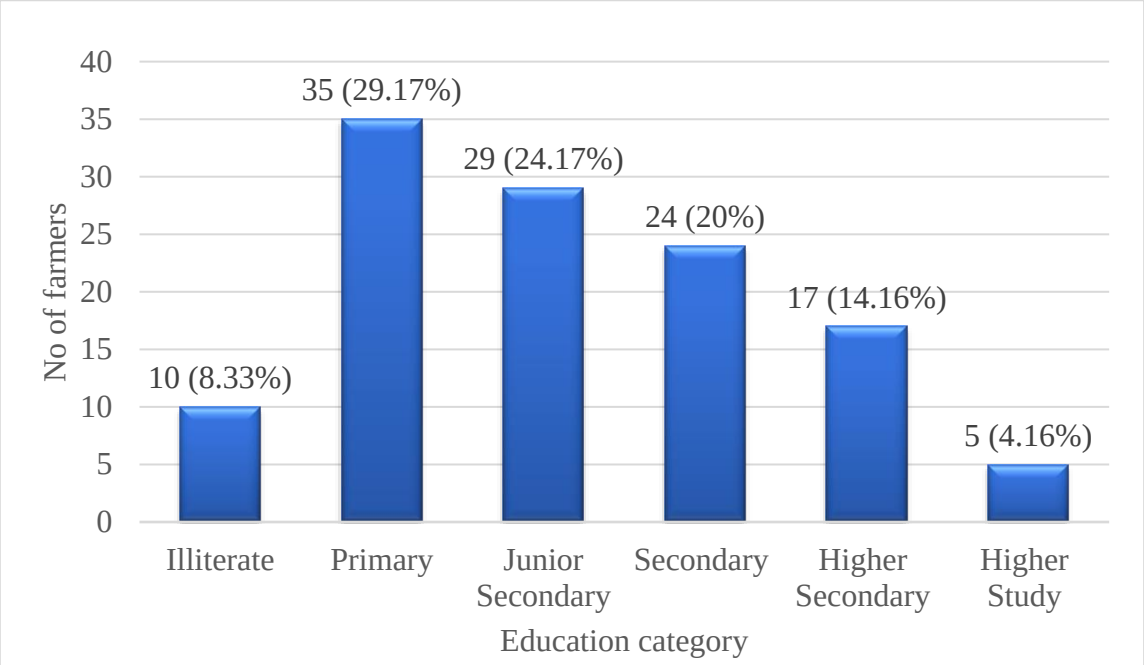


Figure 5.2: Educational status of the Dairy Farmers in Study Area

Source: Field survey, 2022.

Note: Education category has been adopted from Ministry of Education, 2016

Out of 120 sample farmers in the savar upazila, Figure 5.2 revealed that approximately 8.33 percent of the study population had no formal education, while approximately 91.67 percent of farmers were literate. Of these, roughly 29.17 percent of farmers had completed their primary education, 24.17 percent had completed their junior secondary education, 20 percent had completed their secondary education, 14.16 percent had completed their junior secondary education, and only 4.16 percent had completed their higher education.

5.4 Distribution of the Respondents Based on Gender

According to this study, in Savar Upazila, out of 120 sample farmers both men and women are more likely to work as dairy farmers. Farming encouraged women in achieving sustainable development by enhancing their socioeconomic conditions. Figure 5.3 showed that 29.17 % female and 70.83% male are dairy farmers in the study area.

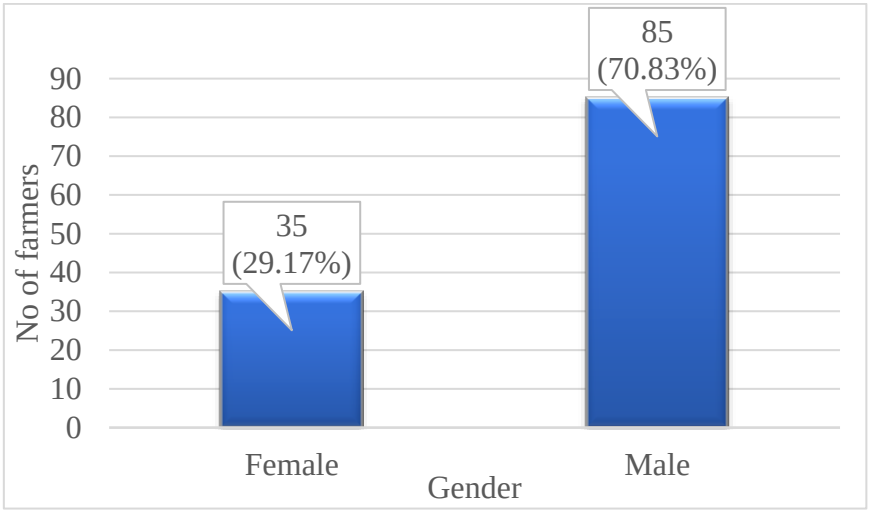


Figure 5.3: Gender Ratio of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.5 Distribution of the Respondents Based on Occupation

A person's occupation is the work, play, or daily activities that they engage in within the framework of their physical and social environment and that have cultural significance (Kielhofner, 1995). Depending on their level of involvement and income from their current job, people's primary occupations vary greatly in distribution.

5.5.1 Major Occupation

Out of 120 sample farmers in the Savar Upazila, this study found that, about 7.5 percent, 4.17 percent, 1.67 percent, 5 percent, 60 percent, 6.67 percent and 15 percent were engaged in business, crop farming, day-labor, house rent, livestock rearing, remittance and service respectively as their main occupation (Figure 5.4).

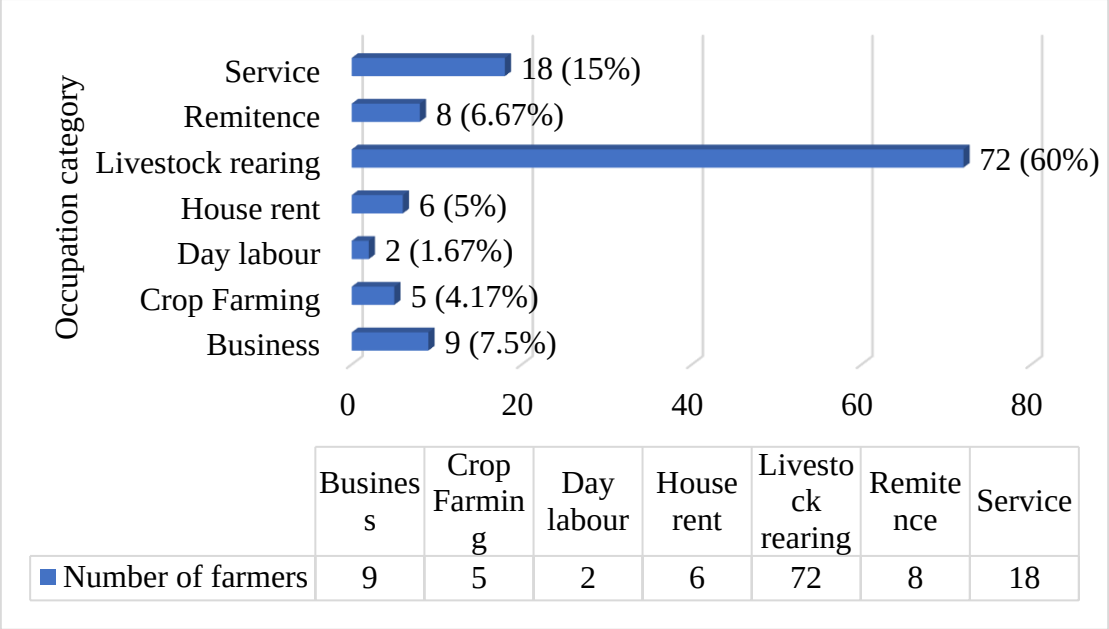


Figure 5.4: Main occupation of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.5.2 Subsidiaries Occupation

In the study area, out of 120 sample farmers about 15.83 percent, 7.5 percent, 8.33 percent, 4.17

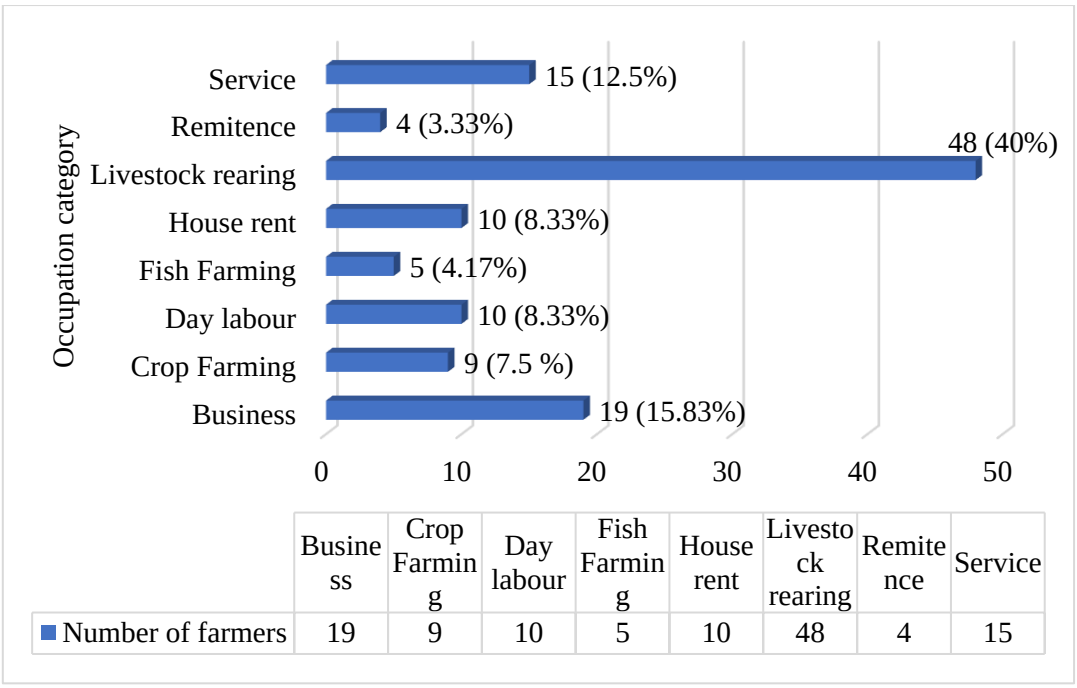


Figure 5.5: Subsidiaries Occupation of the Dairy Farmers in Study Area

Source: Field survey, 2022.

percent, 8.33 percent, 40 percent, 3.33 percent and 12.5 percent were engaged in business, crop farming, day-labor, fish farming, house rent, livestock rearing, remittance and service respectively as their subsidiary's occupation (Figure 5.5).

5.6 Distribution of the Respondents Based on Family size

The total amount of persons living under one roof with one family head is known as the family size. The average family size in the study area was 5.31 in upazila, which is higher than the national average of 4.06 (HIES, 2016). Out of 120 sample farmers in Savar Upazila, households had a maximum of 14 members and a minimum of 3 members, respectively.

Table 5.3: Summary of Respondent's Family Size in Study Area

Criteria	Mean	Min	Max
Family size	5.31	3	14

Source: Field survey, 2022.

The total numbers of persons of all families were divided into three categories according to their family size. The different family size of dairy farmers is presented in Table 5.6. Table indicates that about 66.67 percent families of dairy farmers consisted of 2-5 members, 29.17 percent families consisted of 6-10 members and about 4.16 percent families consisted more than 10 members.

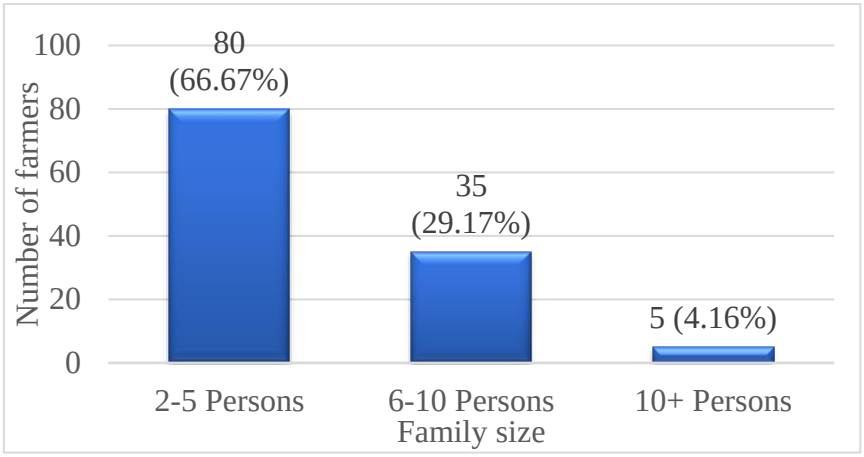


Figure 5.6: Family Size of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.7 Distribution of the Respondents Based on Breed Type Used

In the study area, out of 120 sample farmers majority use Holstein Friesian cross breed, followed by local breed, Jersey cross and Sindhi cross cattle are raised by the fewest number of farmers. (Figure 5.7)

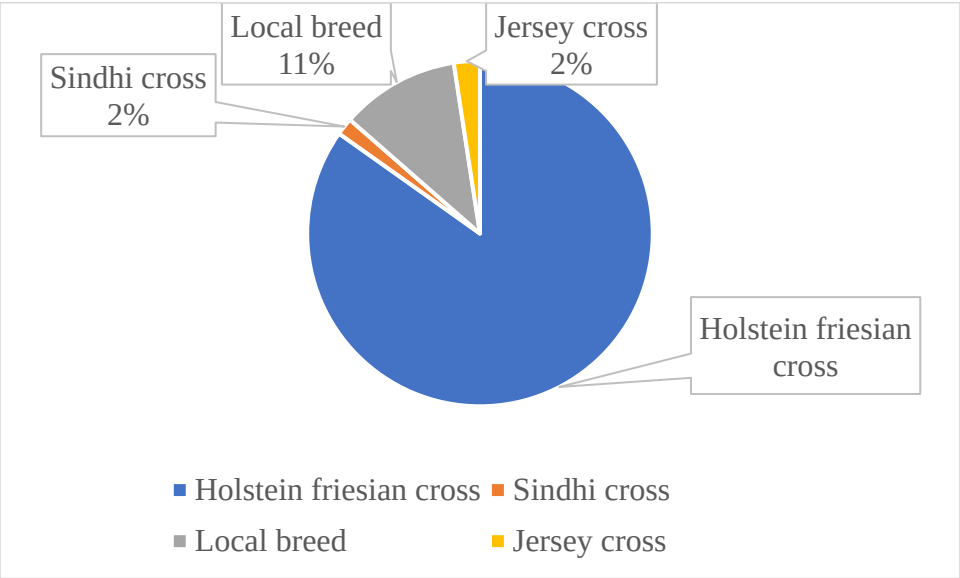


Figure 5.7: Breed type of the Dairy Farm in Study Area

Source: Field survey, 2022.

5.8 Distribution of the Respondents Based on Farm Size

The number of milking cows in the herd is used in this study to define the size of dairy farms. Based on this definition, Jabbar et al. (2005) classified dairy farms into three categories: small, medium, and large, with 1-3, 4-5, and 5+ cows, respectively. Table 5.4 lists the farm sizes of the 120 sample farmers.

Table 5.4: Farm Size in Study Area

Farm Size	Number of Farms
Small farm	84
Medium Farm	28
Large Farm	8

Source: Field survey, 2022.

Within the study area, of the 120 sample farms, 70 percent are small farms, 23.33 percent are medium farms, and 6.67 percent are large farms. There are more small dairy farmers in the research area. (Figure 5.8)

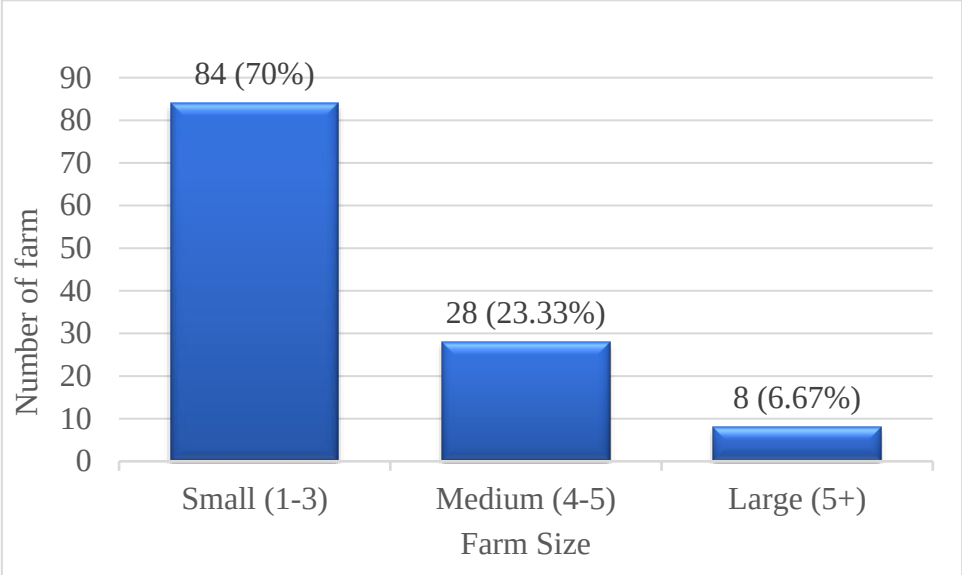


Figure 5.8: Farm Size of the Dairy Farm in Study Area

Source: Field survey, 2022.

In the study area average milking cow is 3.15 and farms had a minimum of 1 milking cow and a maximum of 17 milking cow. (Table 5.5)

Table 5.5: Summary of Respondent's Number of Milking Cow in Study Area

Criteria	Mean	Min	Max
Milking Cow	3.15	1	17

Source: Field survey, 2022.

5.9 Distribution of the Respondents Based on Cultivating Green fodder

For dairy cattle, green fodder is an affordable source of nutrition. It is quite delicious and easily digestible. Under a mixed feeding system, the microorganisms in green fodder help in increasing the digestion of crop leftovers. Also, it helps animals stay healthy and increase their ability to reproduce. In the Study area, farmers cultivate different types of green grass like german, napier/pakchun. and maize to feed the cattle. Moreover, some farmer uses both cultivated grass and locally grown grass, hydroponic grass. In Figure 5.9 we can see that out of 120 farmers, 17 percent, 28 percent and 10 percent farmers only use cultivated German

grass, Napier grass, Maize grass respectively. While 9 percent farmers use cultivated German grass and locally grown Hydroponic grass, 11 percent farmers use cultivated German grass and locally grown grass, 14 percent farmers use cultivated Napier grass and locally grown Hydroponic grass, 9 percent farmers use cultivated Napier grass and locally grown grass and 2 percent farmers use cultivated Maize grass and locally grown Hydroponic grass. (Figure 5.9)

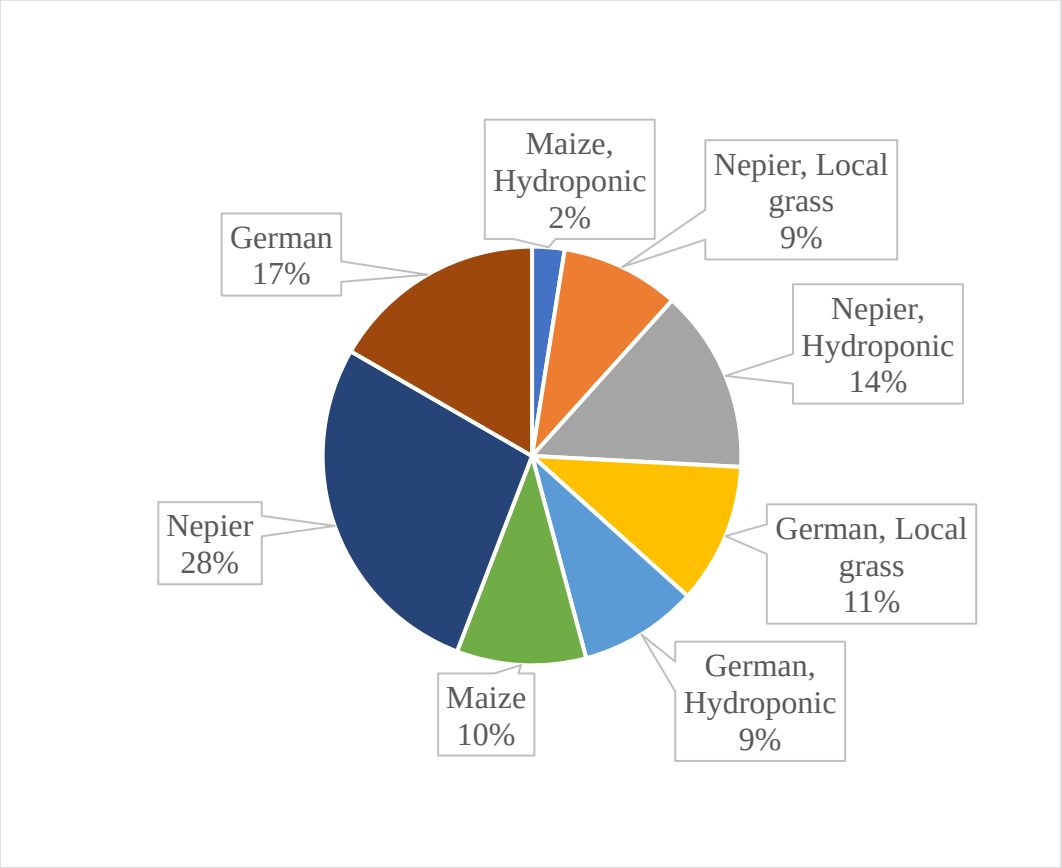


Figure 5.9: Green Fodder Feeding Practice of the Dairy Farms in Study Area

Source: Field survey, 2022.

5.10 Distribution of the Respondents Based on Farming Experience

From the collected data (out of 120 sample dairy farmers) it can be estimated that the average dairy farming experience was 7.18 years. Table 5.6 displayed the minimum and maximum dairy farming experience were observed to be 2 years and 21 years respectively.

Table 5.6: Summary of Respondents Farming Experience in Study Area

Criteria	Mean	Min	Max
Dairy Farming Experience	7.18	2	21

Source: Field survey, 2022.

5.11 Distribution of the Respondents Based on Training

Among the sample 120 farmers, 57 percent farmers got training on different farm practice whereas, 43 percent did not get any training. (Figure 5.10)

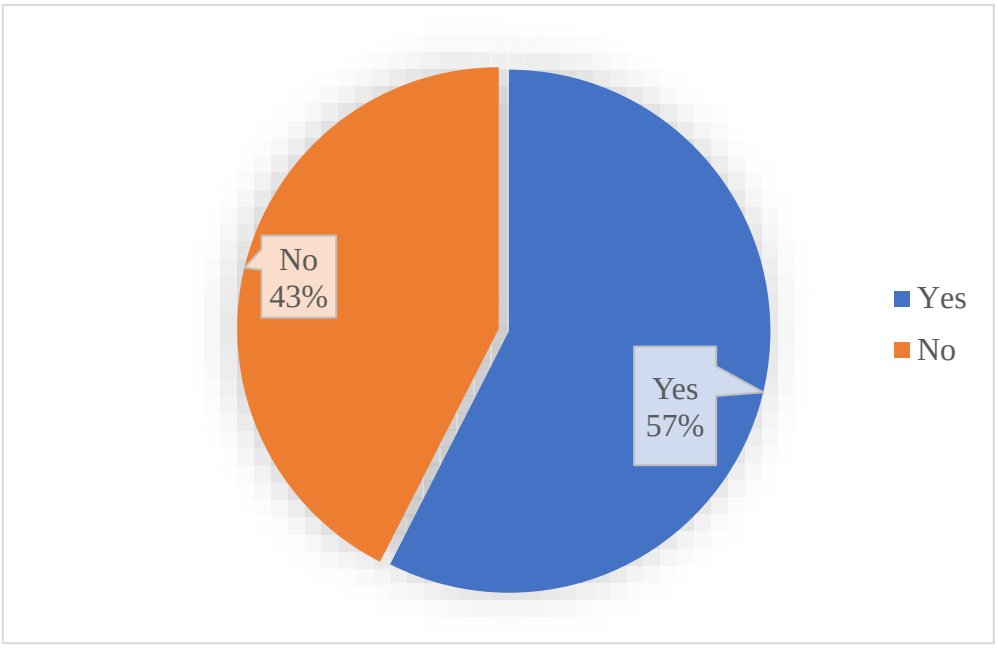


Figure 5.10: Training of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.12 Distribution of the Respondents Based on Membership on Social Organization

Figure 5.11 showed that among 120 respondent farmers 28 percent of dairy farmers have membership in different organization and 72% of farmers have no membership in any organization.

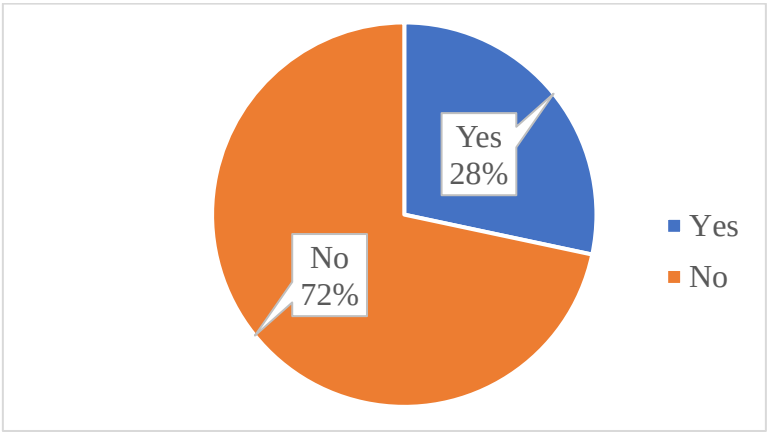


Figure 5.11: Membership on Social Organization of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.13 Distribution of the Respondents Based on Membership on Access to Veterinary Service

Figure 5.12 showed that among 120 respondent farmers 91 percent of dairy farmers have access to veterinary doctor, medicine etc. and 9 percent of farmers have no access to veterinary service.

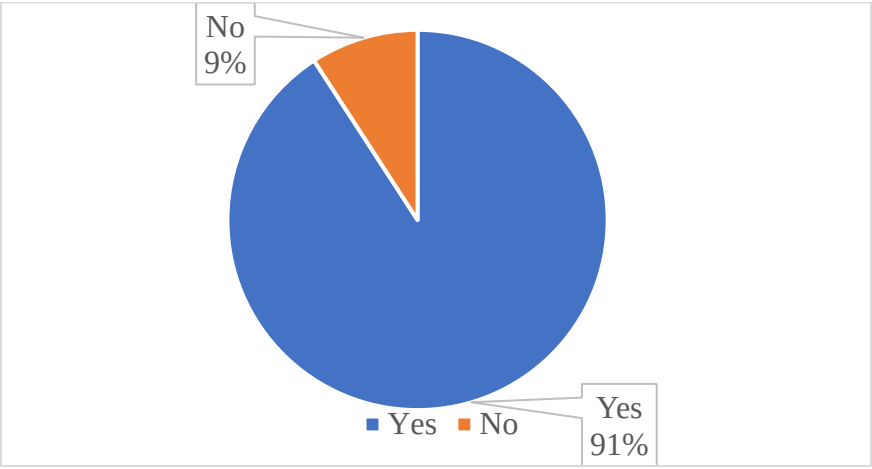


Figure 5.12: Access to Veterinary Service of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.14 Distribution of the Respondents Based on Receiving Credit Service

For any type of farming enterprise, having enough capital is essential. In the research area, most of the farmers didn't have credit facilities for dairy farming. About 17 percent farmers were taken loan from Relatives, Banks and different NGO's and 83 percent farmers were used their own funding for dairy farming (Figure 5.13).

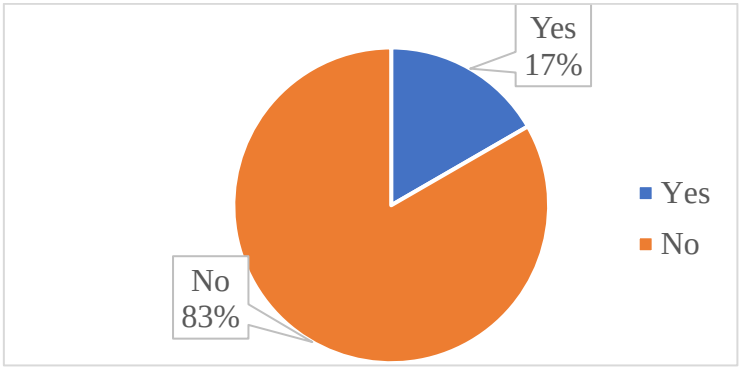


Figure 5.13: Credit Facilities of the Dairy Farmers in Study Area

Source: Field survey, 2022.

5.15 Distribution of the Respondents Based on Distance from Home to Local Market

From the collected data (out of 120 sample dairy farmers) it can be estimated that the average distance from home to market was 1.80 km. The minimum and maximum distance to local market were observed to be 0.6 km and 4 km respectively. (Table 5.7)

Table 5.7: Summary of Respondent's Farm Distance to Local Market in Study Area

Criteria	Mean	Min	Max
Distance to Local Market	1.80	0.6	4

Source: Field survey, 2022.

5.16 Concluding Remarks

This chapter analyzed the socioeconomic traits of the sample farmers of Savar Upazila. In the next chapter productivity and technical efficiency of dairy farms will be discussed.

CHAPTER 6

PRODUCTIVITY AND TECHNICAL EFFICIENCY OF THE DAIRY FARMERS

6.1 Introduction

The production function is applying to determine productivity and technical efficiency is a commonly applied econometrics method. Productivity and technical efficiency (TE) refer to how well a certain combination of inputs is used to generate the highest possible output. When a company produces the most output with the least number of inputs—labor, capital, and technology—it is considered technically efficient. In other words, technical efficiency estimates allow understanding if farms are properly using the inputs at disposition, as well as the possible income gains resulting for an improvement of the inputs use. Conversely, productivity is usually interpreted to be the correlation between the quantity of a product produced (output) and the quantity of one or more inputs needed to produce it. Consequently, productivity may be characterized as the farm's capacity to convert inputs into the final product at a given degree of expertise and technology. While TE measures the degree of adherence to the observed production process to an optimality standard, it also provides an indication of the capacity to convert the inputs. Because each farmer's output performance is evaluated in comparison to a production frontier, or ideal input-output relationship, the concept is relative. Since they are unable to maximize output given a given quantity of inputs, farmers are seen as technically inefficient. The primary goal of this chapter is to figure out the productivity and technical inefficiency as well as the frequency distribution of milk producers through an examination of productivity and technical efficiency.

6.2 Interpretation of ML Estimates of the Stochastic Frontier Production Function

The stochastic frontier analysis technique makes the assumption that a random parameter that is outside of the control of farmers and the inefficiency of the farm—which affects farmer decision-making—determine how far the farm deviates from the efficient frontier. A mathematical concept called the Likelihood Function of the sample data is utilized to initiate

the maximum likelihood estimation procedure. The likelihood of a set of data, given the chosen probability distribution model, is the likelihood of obtaining that particular set of data. This formula includes these parameters for the model. The parameters that maximize the likelihood of the sample are called Maximum Likelihood Estimates, or MLEs. The maximum likelihood estimates for the technological inefficiency effect model and the Cobb-Douglas stochastic frontier production function parameters for dairy production for all dairy farmers are displayed in Table 6.1.

6.2.1 Hired labor (Tk/cow/year) (X_1)

The magnitude of coefficients of hired labor cost (X_1) of dairy farm was positive and significant at 10 percent level. The regression coefficients of hired labor cost (X_1) was 0.006 which implied that, keeping other factors constant (price of roughage feed cost, price of concentrated feed cost, price of veterinary cost and so on), 1 percent increase in hired labor cost per cow would increase the revenue of dairy farm by 0.006 percent (Table 6.1). The most likely reason for this there has scope for increasing revenue by increasing hired labor.

6.2.2 Family labor (Tk/cow/year) (X_2)

The magnitude of coefficients of family labor cost (X_2) of dairy farm was positive and significant at 1 percent level. The regression coefficients of family labor cost (X_2) was 0.026 which implied that, keeping other factors constant (price of roughage feed cost, price of concentrated feed cost, price of veterinary cost and so on), 1 percent increase in family labor cost per cow would increase the revenue of dairy farm by 0.026 percent (Table 6.1). The most likely reason for this there has scope for increasing revenue by increasing family labor.

6.2.3 Concentrate feed (Tk/cow/year) (X_3)

The magnitude of coefficients of concentrate feed cost (X_3) of dairy farm was positive and significant at 5 percent level. The regression coefficients of concentrate feed cost (X_3) was 0.230 which implied that, keeping other factors constant (price of roughage feed cost, price of

hired labor cost, price of veterinary cost and so on), 1 percent increase in concentrated feed cost per cow would increase the revenue of dairy farm by 0.230 percent (Table 6.1). The most likely reason for this there has scope for increasing revenue by increasing concentrate feed with proper ration balancing.

Table 6.1: ML Estimates for Parameters of Cobb-Douglas Stochastic Frontier Production Function and Technical Inefficiency Model for Dairy Farm

Variables	**Parameter**	**Coefficients**	**Standard errors**	**P-values**
Stochastic Frontier				
Constant (X_0)	β_0	8.869***	1.242	0.000
Hired labor (X_1)	β_1	0.006*	0.004	0.060
Family labor (X_2)	β_2	0.026***	0.009	0.005
Concentrate feed (X_3)	β_3	0.230**	0.101	0.023
Roughage feed (X_4)	β_4	0.113**	0.053	0.033
Veterinary (X_5)	β_5	-0.748***	0.092	0.000
Utility (X_6)	β_6	0.671***	0.063	0.000
Inefficiency Model				
Constant	δ_0	0.367	0.887	0.679
Education (Z_1)	δ_1	-0.097*	0.050	0.053
Farm experience (Z_2)	δ_2	-0.158**	0.080	0.049
Training (Z_3)	δ_3	-0.983***	0.369	0.008
Veterinary service (Z_4)	δ_4	-1.650***	0.543	0.002
Agricultural credit (Z_5)	δ_5	0.344	0.461	0.455
Distance to market (Z_6)	δ_6	0.074	0.053	0.160
R^2	0.762			
Adjusted R^2	0.736			

Note: *** denotes significant at 1 percent level, ** denotes significant at 5 percent level and * denotes significant at 10 percent level.
Source: Field survey, 2022

6.2.4 Roughage feed (Tk/cow/year) (X_4)

The magnitude of coefficients of roughage feed cost (X_4) of dairy farm was positive and significant at 5 percent level. The regression coefficients of concentrate feed cost (X_4) was 0.113 which implied that, keeping other factors constant (price of hired labor cost, price of veterinary cost, price of utility and so on), 1 percent increase in roughage feed cost per cow would increase the revenue of dairy farm by 0.113 percent (Table 6.1). The most likely reason for this there has scope for increasing revenue by increasing roughage feed.

6.2.5 Veterinary cost (Tk/cow/year) (X_5)

The magnitude of coefficients of veterinary cost (X_5) of dairy farm was negative and significant at 1 percent level. The regression coefficients of veterinary cost (X_5) was 0.748 which implied that, keeping other factors constant (price of hired labor cost, price of feed cost, price of utility and so on), 1 percent increase in veterinary cost per cow would decrease the revenue of dairy farm by 0.748 percent (Table 6.1). The most likely reason for the negative sign may be due to the overused or improper use of veterinary service (doctor, medicine etc.).

6.2.6 Utility cost (Tk/cow/year) (X_6)

The magnitude of coefficients of utility cost (X_6) of dairy farm was positive and significant at 1 percent level. The regression coefficients of utility cost (X_6) was 0.671 which implied that, keeping other factors constant (price of hired labor cost, price of veterinary cost, price of feed cost and so on), 1 percent increase in utility cost per cow would increase the revenue of dairy farm by 0.671 percent (Table 6.1). The most likely reason for this there has scope for increasing revenue by increasing utility or improving housing management.

6.3 Interpretation of Technical Inefficiency Model

In the technical inefficiency effect model education, farm experience, training and veterinary service are expected (negative) coefficients (Table 6.1).

6.3.1 Education (Z_1)

The coefficient of education is negative and significant at 10 percent level which implies that more year of schoolings made farmers technically more efficient. The most likely reason for this might be that educated farmers aware more about scientific knowledge of dairy farming compared to illiterate or less educated farmers. (Table 6.1).

6.3.2 Farm experience (Z_2)

The coefficient of experience is negative and significant at 5 percent level which implies that more experienced farmers are technically more efficient than less experienced farmers. The most likely reason for this might be that experienced farmers aware more about dairy farming and can cope up any uncertain situation. (Table 6.1).

6.3.3 Training (Z_3)

The coefficient of training is negative and significant at 1 percent level which implies that farmers receiving training are technically more efficient than those who don't have received training. The most likely reason for this might be that farmers with training have a better understanding of current farming techniques than farmers without training. (Table 6.1).

6.3.4 Veterinary service (Z_4)

The coefficient of veterinary service is negative and significant at 1 percent level which implies that the farmers receiving veterinary service is technically more efficient than who don't have received veterinary service. The most likely reason for this might be that by taking veterinary service farmers takes good care of their cattle so the farm is more efficient. (Table 6.1).

6.3.5 Agricultural credit (Z_5)

The coefficient of agricultural credit was not statistically significant. (Table 6.1).

6.3.6 Distance to market (Z_6)

The coefficient of distance to market was not statistically significant. (Table 6.1).

6.4 Technical Efficiency Distribution

Determining whether to increase productivity by improving the current efficiency level depends on the estimation of the technical efficiency level. A farm is considered technically inefficient if it is unable to maximize the amount of an input that is used. Table 6.2 displays the technical efficiency of dairy farming at farm level estimation in the research area.

Table 6.2: Frequency Distribution of Technical Efficiency of Dairy farm

Efficiency Category (%)	No of Farms	Percentage of Farm
0-75	4	3.33
76-80	6	5
81-85	7	5.83
86-90	13	10.83
91-95	29	24.16
96-100	61	50.83
Total number of observations	120	
Minimum	0.71	
Maximum	0.99	
Mean	0.92	
Standard Deviation	0.069	

Source: Field survey,2022

The frequency distribution of dairy farmers' farm-specific technical efficiency is displayed in Table 6.2. It shows that the average estimated technical efficiencies for dairy farms are 92%, meaning that 8 percent more dairy products could be produced for the same amount of inputs without adding to the costs. For dairy farms, an increase in managerial skills alone leads to a significant increase in output. It was discovered that 50.83 percent of the sample farmers had outputs that were nearly identical to the maximum outputs allowed by the frontier while still maintaining an efficiency level above 96 percent. However, the second-highest percentage of respondents—roughly 24.16 percent of sample farmers—obtained a technical efficiency level between 91 and 95 percent. The mean and standard deviation remained at 0.92 and 0.069,

respectively, while the minimum and maximum technical efficiencies were observed to be 71 and 99 percent, respectively.

6.5 Coefficient of Multiple Determinations (R^2)

According to the values of the coefficient of multiple determination of dairy farming, which was found to be 0.762 (Table 6.1). Approximately 76.2 percent of the variation in the gross return of dairy farms could be explained by the explanatory variables included in the model.

6.6 Adjusted R^2

According to the degrees of freedom, adjusted R2 is calculated. With an adjusted R2 of 0.736 for dairy production, it was determined that the explanatory variables in the model accounted for approximately 73.6% of the variations in the farm's output (Table 6.1).

6.7 Diagnostic Test

To run the stochastic frontier production model researcher, researcher has used both continuous and dummy variables as independent variable. There may be correlations between the variables selected for analysis. Avoiding correlation between the independent variables is very important for research reliability. Hence, a correlation matrix is used to detect the multicollinearity. Here, the correlation matrix indicate that multicollinearity is not an issue in the study (Appendix-A). In addition, link test has also been conducted to find the validity of the model specification. Results shows that the hatsq value is 0.905 which is insignificant. Hence, the model specification is valid and there is no omitted variable issue in the model (Appendix-A).

6.8 Concluding Remark

The explanation of the various inputs and their degree of efficiency at the farmer level provided above makes sense. The productive use of these inputs is essential to dairy farm production. Based on the above discussions, one could cautiously draw the conclusion that dairy farming is profitable and that there is scope for production growth through the reduction of technical inefficiencies at the farm level. The challenges that dairy farmers face are depicted in the following chapter 7.

CHAPTER 7
PROBLEMS OF DAIRY PRODUCTION

7.1 Introduction

This chapter's main goal is to determine the range of the issues facing dairy farmers. Dairy farming presented numerous challenges to farmers. The issues encompassed financial, technical, social, and cultural aspects. The goal of this chapter is to outline some of the socioeconomic issues and limitations that dairy farms face. The opinions of the farmers were used to identify the issues and limitations they faced. The following discusses the main issues and level of restrictions associated with dairy farming:

7.2 High Price of Feed

One of the major feed components that contributes to the production of milk is green grass. The grazing land is not available in the urban areas due to the population increase. Farmers have to cultivate their own roughage feed or purchase from market. Unavailability of concentrate feed which leads to high feed cost was identified as one of the severe constraints during dairy farming in the study area. For example, the price of 1-kg of wheat bran has increased from TK 22 to Tk 37. From Table 8.1 it is evident that about 97.5 percent dairy farmers in study areas reported this as high problem whereas high price of input was a moderate problem to about 2.5 percent of respondents in Savar upazila. It was a severe problem for dairy production and ranked 1st among the problems.

7.3 Lack of Capital

The study area's farmers experienced financial difficulties. For dairy farming a huge amount of cash money was needed to purchase various inputs like milking cow, feed, labor, veterinary cost, medicine etc. In the study area from 120 sample farmers, 75.83 percent farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises and marked as high problem. (Table 7.1). The problem was medium for about 20 percent of farmers and about 4.17 percent of farmers reported this problem as low. In the rank order, problem of lack of capital is the 2nd in the study area.

7.4 Lack of Marketing

"Marketing makes the exchange process more meaningful to the parties involved in the exchange. One party gain in term of needs and wants satisfaction and the other gains profit by promoting satisfaction (Kotler, p.22)". In the study area due to the Dairy farmers occasionally sell their milk directly to nearby businesses like tea shops, restaurants, and the local market. They sell their milk mostly through various middlemen, including gowalas, rattars, and retailers at a lower price. Out of 120 sample farmers about 75 percent farmers faced the problem of lack of marketing facilities and reported as high rank. 14.17 percent, 7.5 percent and 3.33 percent farmer marked this problem as medium, low and not at all respectively (Table 7.1). This problem is ranked as 3rd in the study area.

Table 7.1 Problems and Degree of Constraint of Dairy Production in the Study Area

Type of Problems	Rank	Not at all		Low		Medium		High	
		No	%	No	%	No	%	No	%
High Price of Feed	1st	0	0	0	0	3	2.5	117	97.5
Lack of Capital	2nd	0	0	5	4.17	24	20	91	75.83
Lack of Marketing	3rd	5	4.16	9	7.5	17	14.17	89	74.17
Shortage of Labor and High Labor Cost	4th	4	3.33	8	6.67	25	20.83	83	69.17
Lack of Technical Knowledge	5th	0	0	21	17.5	33	27.5	66	55
Lack of Training Facilities	6th	10	8.3	59	49.17	25	20.83	26	21.67
Inadequate Veterinary Service	7th	5	4.16	80	66.67	21	17.5	14	11.67
Lack of Milk Storage Facilities	8th	7	5.83	99	82.5	8	6.67	6	5

Source: Field survey, 2022

7.5 Shortage of Labor and High Labor Cost

The issue of excessive labor costs and non-availability of human labor have recently become very problematic for dairy farmers. Dairy farming requires daily labor, so farmers must pay large labor costs on an annual basis. Every household almost always complains about this issue. For example, the monthly labor expense for a farm with five cows is TK 12,000. In the study area. 69.17 percent farmers refer that shortage of labor and high labor cost as a severe problem. About 20.83 percent 6.67 percent and 3.33 percent farmers rank this as medium low and not at all respectively. In the rank order, problem of shortage of labor and high labor cost is the 4th in the study area (Table 7.1).

7.6 Lack of Technical Knowledge

Although modern techniques have been using in the study area but our farmers have lack of knowledge about veterinary supports, notably breeding and cross breeding, milk quality, quantity of feed. In the study area from 120 sample farmers, 55 percent farmers reported this as high problem 27.5 percent of farmers were encountered this problem as medium and about 17.5 percent of farmers reported this problem as low (Table 7.1). This rank as 5^{th} problem in the study area.

7.7 Lack of Training Facilities

Farmers' income and enthusiasm in raising livestock can be considerably improved by timely training. Farmers in the study area have access to numerous training facilities. Among 120 sample farmer, 8.33 percent farmers reported they had enough training facilities and rank that lack of training is not a problem for them. About 49.16 percent farmers reported that they have access to training facilities and rank as low-level problem. 20.83 percent and 21.67 percent farmers rank this lack of training facilities as medium and high respectively. This rank as 6^{th} problem in the study area. (Table 7.1).

7.8 Inadequate Veterinary Service

In terms of treatment and medication accessibility, it was discovered that almost all of the respondents in the research locations had previously used some kind of animal health services. However, it was observed that only a few numbers of villages received other essential services for their health and productivity, aside from general consultation and disease diagnosis and treatment. In the case of emergency, the farm owners failed to bring them at their houses. The farmers had to pay high charges to the veterinary doctors for every calling. In the research

areas, the demand for the animals needed for disease control is not met by the local livestock office's supply of vaccines, tablets etc. The farm owners had to pay a higher price to buy the necessary medications from the market. Among 120 sample dairy farmers, 11.67 percent, 17.5 percent, 66.67 percent and 4.17 percent dairy farmers rack the problem of access to veterinary service as high, medium, low and not at all respectively. This rank as 7th problem in the study area. (Table 7.1).

7.9 Lack of Milk Storage Facilities

Milk is very perishable due to its remarkable ability to support the growth of germs, particularly bacterial pathogens, which can degrade food and infect consumers. Milk must be kept in a cold temperature to avoid spoiling. Farmers would face great lose if they couldn't sell their milk in time or keep it in storage. In study area, 5 percent farmers reported this as a high problem that they did not have sufficient storage facilities to keep the milk for longer time. (Table 7.1). The problem was medium for about 6.67 percent of farmers and about 82.5 percent of farmers reported this problem as low, lastly 5.83 percent farmers told it’s not a problem for them. This rank as 8th problem in the study area.

7.10 Concluding Remark

The previously mentioned conversations and the findings shown in Table 7.1 suggested that dairy farmers in the research region are currently dealing with a number of significant issues. For the sake of improved output, action should be taken to lessen or eradicate these issues. Adequate focus is required to improve the allocation of subsidies to dairy farmers and grant them access to veterinary and educational facilities.

CHAPTER 8

SUMMARY, CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

Considering the discussions in the previous chapters, this chapter concentrates on the overview. A conclusion has been drawn based on the empirical data. In order to address Bangladesh's dairy production's current inefficiencies, policy recommendations are made.

8.2 Summary

Agriculture sector is the main economic driving force which have impact on major macroeconomic objective. The agriculture sector is crucial for Bangladesh's economic growth, food security, and employment opportunities, as it contributes 11.50% to the GDP and employs around 40.60% of the labor force (BER, 2022). Despite being vulnerable to climate change, Bangladesh has been able to increase crop production and maintain food security. According to the Bangladesh Bureau of Statistics (BBS, 2021) crops, livestock, fisheries, and forest products accounted for about 12.09 percent of Bangladesh's total GDP and employed approximately 40 percent of the total population. As per Bangladesh Economic Review (BER) therefore, the country is now on the threshold of attaining self-sufficiency in food production. The broad agricultural sector (crops, animal farming, forests and fishing) contributes 11.50 percent to GDP, provides employment about 40.60 percent of the labor force (BER, 2022). Among them livestock plays a crucial economic role.

In Bangladesh, the livestock sector is one of the fastest-growing. It can solve the problems of malnutrition, unemployment, empowerment of women, growth of fertility of agricultural land, making talented nation and earning foreign exchange. Meat, egg and milk play in a vital role to meet the demands food of animal origin in our everyday life. The contribution of livestock sector to the GDP in FY 2021-22 is 1.90 percent and the contribution of livestock to the overall agricultural sector is 16.52 percent. About 44 percent of the animal protein comes from livestock sources. Moreover, 4.31 percent of the total export is from the export of leather and leather goods. The 30 percent of the total tillage is still covered by livestock beside mechanical tillage. Furthermore, 20 percent of the population is directly and 50 percent of the population

is partially dependent on livestock sector. The sub-sector enjoyed a growth rate of 3.10 percent during the last fiscal year (BER,2022). Production of meat, milk and egg is 92.65 Lakh Metric Ton meat, 130.75 Lakh Metric Ton milk, 2335.35 Crore numbers egg in Fiscal year 2021-2022. In FY 2012-13 milk production is 50.70 Lakh Metric Ton which is 130.74 Lakh Metric Ton in FY 2021-22. Per capita availability of milk, meat and egg rose to 208.61 ml/day, 147.84 gm/day and 136.01 no's/year respectively in FY 2021-2022. In the financial year 2020-2021 Total demand is 154.94 lakh mt against production 119.85 lakh mt. 193.38 ml per day in terms of availability per person. According to this, the country's production has increased by 13.05 lakh MT. Demand, production and availability of milk, meat and eggs in FY (2021-22)

The sampling frame for the present study were selected purposively as to select the area where the dairy production was intensive. On the basis of higher concentration of dairy farm, eight villages namely Hijali, Bardeshi (Amin Bazar Union), Chakulia, Gandharia (Bongaon Union), Sarulia, Bhomka (Birulia Union), Rajasan, Majidpur (Savar Paurashava Union) were selected purposely in order to collect data. Finally, 15 dairy farmers from each village have been selected as samples for the study.

Dairy farming is a year-round. Considering this situation, few specific objectives of the study were taken to measure the productivity and technical efficiency of dairy production in few selected areas of Bangladesh. These were,

- To explore the socio-demographic profile of dairy farmers.
- To measure the productivity of milk production.
- To investigate the technical efficiency of dairy farms.
- To identify the problems facing by dairy farmers and suggest policy option to solve these problems.

Data for the present study were collected during the period of August 2022 to September 2022. Field surveys were used to get primary data, while publications and statistics bulletins were used to gather secondary data. Selected respondents were interviewed personally with the help of pre-tested semi-structured questionnaires. To ensure consistency and accuracy, the gathered data were examined and verified. Before entering the data into the computer, editing and coding were performed. To avoid any potential inaccuracies, all the data were carefully analyzed and summarized. Data were typically presented in tabular form since it was commonly utilized, had

simple calculations, and was straightforward to comprehend. Using the relevant tools STATA and Microsoft Excel, data analysis was completed.

The study area's features have been briefly summarized. For the aim of the study, the location, physical features, topography and soil condition, area and population, economy, and climate, temperature and rainfall of the chosen area were discussed.

The socioeconomic characteristics considered in the present study were age, education, gender, family size, occupation, breed type, farm size, dairy farming experience, training, receiving credit service, veterinary service, membership of social organization and distance to market. In the study area, maximum (65.83 percent) of respondents were between age of 36 to 50. However, 8.33 percent of the study population had no education, 29.17 percent respondents who have completed their schooling 1-5 is considered primary education, 24.17 percent respondents who have completed their schooling 6-8 is considered junior secondary school, 20 percent respondents who have completed their schooling 9-10 is considered secondary school, 14.16 percent respondents who have completed their schooling 11-12 is considered higher secondary and only 4.16 percent had completed their higher study (schooling 13-17). In the study area, 70.83 percent of them are male dairy farmers and 29.17 percent of them are female. According to Preliminary Report on Household Income and Expenditure Survey (HIES) 2016, respondent's family size was divided into three groups where 66.67 percent of them belonged to small families (of up to 5 people), 29.17 percent to medium families (of 6–10 people), and 4.16 percent to large families (of more than 10 people). Dairy farming used as main as well as secondary occupation in the studied respondent. Sample farmers majority use Holstein Friesian breed, followed by Holstein Friesian cross breed and local breed. Jersey and Sindhi cattle are raised by the fewest number of farmers. According to Jabbar et al. (2005) dairy farm size based on the number of milking cows in the herd and classifies dairy farms as small, medium, and large categories having 1–3, 4–5, and 5+ cows respectively. In the study area 70 percent farms are small size, 23.33 percent farms are medium size and 6.67 percent farms are large in size. In the Study area, farmers cultivate different types of green grass like german, napier/pakchun. and maize to feed the cattle. Moreover, some farmer uses both cultivated grass and locally grown grass, hydroponic grass. The study's findings revealed that the average of the sample farmers dairy farming experience was 7.31 year. Among the respondent farmers, 57 percent of respondent farmer got training on dairy farming whereas, 43 percent farmers did not get

training on dairy farming. Moreover, among the respondent farmers, 91 percent farmers get veterinary service that means farmers had direct or indirect communication with veterinary doctor. however, rest of 9 percent farmers do not get any veterinary service. In the study area the majority farmers didn't have credit facilities for dairy farming. About 17 percent farmers were taken loan from Relatives, Banks and different NGO's and 83 percent farmers were used their own funding for dairy farming. Researcher estimated that the average distance from home to market was 1.80 km.

Productivity and Technical efficiency are the effectiveness with which a given set of inputs is used to produce maximum possible output. Technical inefficiency is then measured as the deviation of a farmer from the best-practice frontier. The regression coefficients of family labor cost (X_2) and utility cost (X_6) were positive where veterinary cost (X_5) was negative and these three variables were highly significant (1 percent level of significance). The coefficient of concentrate feed cost (X_3) and roughage feed cost (X_4) were positive and significant at 5 percent level. The hired labor cost (X_1) was positive and significant at 10 percent level. However, it indicates that if the hired labor cost (X_1), family labor cost (X_2), concentrate feed cost (X_3), roughage feed cost (X_4), and utility cost (X_6) were increased by one percent, the revenue of dairy farm would increase by 0.006, 0.026, 0.230,0.113 and 0.671 percent of sample farmers respectively.

In the technical inefficiency effect model education, farm experience, training and veterinary service are expected (negative) coefficients. The negative coefficient of education and significant at 10 percent level implies that more year of schoolings made farmers technically more efficient. The negative coefficient of experience and significant at 5 percent level implies that experienced farmers are technically more efficient than less experienced farmers. The negative coefficient and at 1 percent level of significance of training implies that farmers receiving training are technically more efficient than those who don't have received training. The negative coefficient and at 1 percent level of significance of veterinary service implies that the farmers receiving veterinary service is technically more efficient than who don't have received veterinary service. Average estimated technical efficiencies for dairy farms are 92 percent which indicate that dairy production could be increased by 8 percent with the same level of inputs without incurring any further cost. The minimum and maximum technical

efficiencies were observed to be 71 and 99 percent respectively where mean and standard deviation maintained at 0.92 and 0.069 respectively.

Farmers faced a lot of problems in dairy farming. The problems were social and cultural, financial and technical. High price of feed was one of the most important problems of dairy farming in the study area. Lack of capital, lack of marketing, shortage of labor and high labor cost, lack of technical knowledge, lack of training facilities and lack of milk storage facilities were the major problems faced by the farmers. These are the major constraints for the dairy farmers in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of milk.

8.3 Conclusion

Dairy farming is an important and potential agricultural sector in Bangladesh. Dairy farming is the only industry where income ensured each month. Milk is a good source of nutrients and is widely used for human consumption. The results of the present study reach to a conclusion that some major scope evidently exists in the study region to boost the productivity of dairy farm. There is an opportunity to increase production of dairy farm by improving the existing production technology. Farmers are relatively inefficient due to high price of feed, less training, less experience, illiteracy, etc. The present study indicates that farmers are technically inefficient that means there is an opportunity to increase production to a large extent using the existing level of dairy farms inputs, the veterinary services and the available technology. If the inputs could be made available to the farmers in reasonable price in time, productivity of dairy farm might be increased which could help them in alleviating rural poverty in many areas. Dairy farming is a yearly business. Therefore, well-planned management training that takes into account their issues, objectives, goal and resource base results in possible production techniques and sustainable dairy farming income.

8.4 Recommendations

Based on the research's findings, it was clear that dairy farming might provide employment and a source of revenue. However, there are few obstacles dairy producers must overcome to achieve the aforementioned goals. Therefore, the decision-makers ought to take the appropriate

action. The study's conclusions suggest that the following particular policy recommendations may be made to advance dairy farming:

a. From findings we found only 29.17% female farmers are engaged in dairy farming. To increase productivity women participation in dairy farming must be increased.
b. Encouraging small and marginal dairy farmers to get veterinary service from registered veterinary doctor. So that they can get high quality of breeding facilities and increase productivity.
c. The dairy farmers should receive adequate training on the necessary feeding quantity, breeding practice, maintaining milk quality etc. This would increase productivity as well as technical efficiency by raising the farmers' technical knowledge
d. Large capital investments are necessary for dairy farming. Land, buildings, equipment, and cows are expensive and few new dairy farmers had the necessary funding. To increase productivity, it is necessary to give subsidies for purchase good breed of cattle as well as shelter for cows. Small and marginal farmers will be encouraged to invest in dairy farming via institutional loans offered at a lower interest rate. A major favorable impact is also produced by collateral-free loans and easy loan disbursement policies.
e. Milk is very perishable product. Farmers would face great lose if they couldn't sell their milk in time or keep it in storage. Dairy farmers need to learn how to preserve the milk for longer time. By creating local storage facilities, it can be solved and improve technical efficiency.

f. Dairy farmers occasionally sell their milk directly to nearby markets, households, tea shops, and restaurants. Most of the time they sell their milk through a variety of middlemen, including gowala, aratdar, and retailers at a lower price. Development of dairy farming depends upon the organized marketing channel in which farmer can get fair price.
g. High price of concentrated and roughage feed was the most important problem during dairy farming. Farmers should be given a reasonable discount on feed cost. To encourage farmers to dairy farming, subsidies for cultivate own green fodder which can minimize the cost of roughage feed cost. Also concentrated feed like grain (corn, wheat, brans etc.), oil cake & meals (soybean meal, mustard oil cake etc.), commercial ready feed, minerals & vitamin etc. should available at minimum price. At this way productivity could increase.

8.5 Limitations of the Study

The study does have some constraints. The following are some of these

a. Most of the information was gathered through interviewing farmers, however occasionally they exhibited little interest to respond.
b. The majority of the information acquired was based on the farmers' memories, which weren't always accurate. There could be some margin for inaccuracy.
c. In-depth research was somewhat impeded by the time and resource limitations.

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APPENDICES-A

Table A-1: Summary Statistics of Different Variables

```
. sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
ln_revenue	120	11.95674	.3677976	10.88681	12.60216
ln_family_~r	120	8.583376	1.475385	0	10.22561
ln_hired_l~r	120	3.186482	4.405208	0	10.02131
ln_concent~t	120	10.95372	.143177	10.4069	11.26119
ln_roughag~t	120	9.555692	.3808909	8.594154	10.73029
ln_veterin~t	120	7.590101	.2322451	7.150702	8.202482
ln_utility~t	120	7.640809	.2839398	6.684612	8.517193
education	120	7.65	3.716079	0	16
farm_exper~e	120	7.183333	3.714571	2	21
training	120	.5416667	.50035	0	1
vet_service	120	.9083333	.2897647	0	1
agricultur~t	120	.1666667	.3742406	0	1
distance_t~t	120	4.455833	3.573626	.25	10
efficiency	120	.9236723	.0689607	.7114664	.9973051

Table A-2: Correlation Matrix

	ln_rev~e	ln_fam~r	ln_hir~r	ln_con~t	ln_rou~t	ln_vet~t	ln_uti~t	educat~n	farm_e~e	training	vet_se~e	agricu~t	distan~t
ln_revenue	1.0000												
ln_family_~r	-0.0008	1.0000											
ln_hired_l~r	0.2567	-0.3064	1.0000										
ln_concent~t	0.1305	0.3293	-0.0939	1.0000									
ln_roughag~t	-0.2186	0.3101	0.0078	0.2542	1.0000								
ln_veterin~t	-0.6202	0.3519	-0.2347	0.1175	0.5568	1.0000							
ln_utility~t	0.4262	0.2068	-0.0974	0.1546	0.1027	0.0418	1.0000						
education	0.4504	-0.2165	0.1643	-0.0379	-0.2838	-0.4202	0.0820	1.0000					
farm_exper~e	0.4191	-0.5002	0.2421	-0.0969	-0.2768	-0.4469	0.0958	0.2525	1.0000				
training	0.3191	-0.1768	0.2627	0.0710	0.0115	-0.2200	0.0198	0.2926	0.3304	1.0000			
vet_service	0.4414	-0.0744	0.1808	-0.0845	-0.3096	-0.3993	-0.0975	0.2431	0.2656	0.0555	1.0000		
agricultur~t	-0.0393	0.0902	-0.0855	-0.0294	0.0399	0.0720	0.0040	0.0181	-0.0403	0.0075	-0.0129	1.0000	
distance_t~t	-0.1848	0.0502	0.1279	0.1055	0.2844	0.2240	0.0935	-0.3009	-0.0413	-0.0337	-0.2129	-0.0683	1.0000

Table A-3: Link Test

```
Stoc. frontier normal/half-normal model          Number of obs     =       120
                                                 Wald chi2(2)      =    265.08
Log likelihood =  14.024921                      Prob > chi2       =    0.0000

------------------------------------------------------------------------------
  ln_revenue |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   1.653711   4.464213     0.37   0.711    -7.095986    10.40341
      _hatsq |  -.0223294   .1862987    -0.12   0.905    -.3874682    .3428094
       _cons |  -4.570963   26.73341    -0.17   0.864    -56.96748    47.82556
-------------+----------------------------------------------------------------
    /lnsig2v |  -5.214186   .5237303    -9.96   0.000    -6.240678   -4.187693
    /lnsig2u |  -2.003539   .1767803   -11.33   0.000    -2.350022   -1.657056
-------------+----------------------------------------------------------------
     sigma_v |   .0737486   .0193122                      .0441422    .1232123
     sigma_u |    .367229   .0324594                      .3088155    .4366915
      sigma2 |    .140296   .0226853                      .0958336    .1847583
      lambda |   4.979468   .0446926                      4.891873    5.067064
------------------------------------------------------------------------------
LR test of sigma_u=0: chibar2(01) = 25.27                 Prob >= chibar2 = 0.000
```

Appendix-B: Research Questionnaire

An Interview Schedule for the Study Entitled

PRODUCTIVITY AND TECHNICAL EFFICIENCY OF DAIRY FARMING IN SOME SELECTED AREAS OF DHAKA DISTRICT.

Serial number: _____ **Date:**

Dear Respondent,
All of your information will be kept confidential and will be used for research purpose only. Please provide the following information.

General information

Respondent's Name:

Address: Village: …….……..……..…… Upazila: ……..……..

District: …….…….. Mobile: ……..……

Socio-economic information

1. Farmer's HH profile

Name of Household members	Age (Years)	Years of Schooling	Sex (M/F)	Sources of income		Yearly Income (Tk)	
				Main	Subsidiaries	Main	Subsidiaries
Self							

(Use code: Crop Farming= 1, Livestock rearing=2, Fish Farming=3, Day labour=4, Service=5, Business =6, others=7)

a) Respondent fathers Years of Schooling? _____

b) Respondent mothers Years of Schooling? _____

c) Respondent marital status?

i) Yes ii) No; if yes, Years of Schooling? ____

d) How many children? ____ , Are they going to school?

e) How many members are engaged in dairy farming?

i) Male: _____ ii) Female: _____

2. Farm Size:

How much land do you have? (decimal)	a) Homestead	b) Own	c) Mortgage in/leased in	d) Pastureland	e) Fallow land	f) Farm Land	g) Others

3. Farm characteristics

Which of the following type of livestock do you have?	How many cows on January 2021		How many cows did you purchased? Between Jan-dec 2021		How many cows did born? Between Jan-dec 2021		How many cows did you sold? Jan-dec 2021	
	No.	Tk	No.	Tk	No.	Tk	No.	Tk
Cattle								
Lactating cows								
Dry cows								
Bull calves								
Heifer calves								
Heifers								
Bulls								

Household: Farm household (Small farm / Medium farm / Large farm household) / Non-farm household. (Technical Efficiency Parameters)

Productivity related information

4. Production cost

a. Investment cost

Item	Investment cost (Tk)	Lifespan (year)	Salvage value (Tk)
Cattle house			
Generator/IPS			
Water pump			
Electric fan			
Other farm machineries			

b. Operating/recurring cost

SL	Item Name	Response	
1.	How many family labour hours per day did you use for dairy farming?	Male	Female
2.	How many hired labour per day did you use for dairy farming?	Male	Female
3.	What is the average wage rate of labour?	Male	Female
4.	How much cost incurred for input and output transport during last year?	Tk	
5.	How much breeding cost incurred during last year?	Tk	
6.	How much veterinary cost (treatment, vaccination, deworming) incurred during last year?	Tk	
7.	How much was the utility (electricity, moskuito coil, net, etc.) and other costs during last one year?	Tk	
8.	How much cost incurred for rental house per month? Or If it is your own house how much will be the rent if you rent the house?	Tk	

c. Feeding practice

Q. Do you cultivate green grass?

i) Yes ii) No ; If yes how much land? (Decimal) _____ and which grass? -

_____

Item	Home Supply	Purchased	Price Per Unit
Name	**Qty (Kg)/day**	**Qty (Kg)/day**	**Tk**
a) Roughage			
i) Straw (Paddy/Wheat)			
ii) Green fodder (Nepier/Pakchun, German, Maiz, Kheshari, Hydroponic grass, local grass)			
iii) Hay			
iv) Silage			
v) UMS			
vi) Others (specify)			
b) Grains			
i) Corn			
ii) Wheat			
iii) Brans			
iv) Rice/ Broken rice			
v) Khesari			
vi) Masur			
vii) Gram			
viii) Mashkalai			
ix) Dubli			
x) Others (specify)			
c) Oil cake & Meals			
i) Soyabean meal			
ii) Sesame oil cake			
iii) Mustard Oil cake			

	iv) Coconut oil cake			
	v) Sunflower oil cake			
	vi) Others (specify)			
d)	**Commercial ready feed**			
e)	**Minerals and Vitamins**			
	i) DCP			
	ii) Common salt			
	iii) Limestone powder			
	iv) Rock Salt			
	v) Premix minerals & vitamins			
	vi) Others (specify)			
f)	**Molasses**			
g)	**Urea**			
h)	**UMB**			
i)	**Others**			

5. Production and productivity characteristics

Sl. of cows	Breed type	Age in years	How many days was the lactation period during last year	How much milk (litter) this cow give during lactation period per day?		
	Code 1			Early	Mid	Last
1						
2						
3						
4						
5						

Code 1: Breed type

Local breed/Deshi 1	Sindhi crosse 8
Holstein-Friesian 2	Sahiwal 9
Holstein-Friesian crosse 3	Sahiwal crosse 10
Jersey 4	Munshiganj 11
Jersey crosse 5	Red Chittagong 12
Gir 6	Pabna breed 13
Sindhi 7	Others (cow) 14

Q. What was the average price of milk /day?

Q. How much manure did you produce last year and cost of manure?

6. Household expenditure (Tk.

Purpose	Unit	Expenditure (Tk.)
a. Consumption expenditure		
i) Food	Weekly	
b. Non-food expenditure		
i) Housing	Yearly	
ii) Cloths	Yearly	
iii) Education	Yearly	
iv) Medical	Yearly	
v) Festivals	Yearly	
vi)Transport	Yearly	
vii) Others (If any)	Yearly	

Technical Efficiency Related Information

8. Dairy Farming Experience: .....Years

9. Do you receive any training on dairy farming? Yes / No

10. Membership on societal organization: Yes / No

11. Do you have access to extension service: Yes / No

12. Do you have access to veterinary doctor: Yes / No

13. Do you have access to mobile veterinary app: Yes / No

14. Distance from home to local market: .....Km

15. Do you receive any agricultural credit? Yes / No

If Yes: Source of Loan? Bank / NGO / Relatives / Others

Amount of Loan (last year): ……Taka

16. Please mention the problems in milk production.

- Lack of capital
- Lack of technical knowledge
- Lack of milk storage facilities
- Lack of marketing
- Lack of training
- Inadequate veterinary service
- Inadequate extension service
- High price of feed.

17. Degree of constraints

Constraints	High	Medium	Low	Not at all
Lack of capital				
Lack of technical knowledge				
Lack of milk storage facilities				
Lack of marketing				
Lack of training				
Inadequate veterinary service				
Inadequate extension service				
High price of feed, medicine, and others electricity bill				

Thank you for your nice cooperation