PHYSIOCHEMICAL CHARACTERISTICS OF RAW MILK & WASTE MANAGEMENT SYSTEM ANALYSIS OF DAIRY FARMS ADJACENT TO BURIGANGA RIVER

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DHAKA, BANGLADESH

APRIL 2023

DECLARATION

I hereby certify that I worked on this research project at Daffodil International University under the guidance of Dr. Mahfuza Parveen, Ph.D., Associate Professor of Environmental Science and Disaster Management (ESDM) (DIU). I hereby further certify that neither this research project nor any component thereof has been previously submitted for the conferral of any degree.

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CERTIFICATE APPROVAL

I am pleased to certify that the thesis report on ― **Physiochemical Characteristics of Raw Milk & Waste Management System Analysis of Dairy Farms Adjacent to Buriganga River**; prepared by Shaifullah Khan holding ID no: 191-30-217 the Department of Environmental Science and Disaster Management, is Approved for Presentation and Defense.

Shaifullah Khan works as an independent researcher under the supervision of Dr. Mahfuza Parveen, Ph.D., Associate Professor of Environmental Science and Disaster Management (ESDM) (DIU). He completed the work with potential fulfillment of the requirement for the degree of Bachelor of Science (B.Sc.) in Environmental Science and Disaster Management, which has been examined and recommended for approval and acceptance.

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ACKNOWLEDGEMENT

I would want to express my deepest appreciation and obligation to all the people who have supported me in my endeavor at the very beginning of this report. I would not have advanced the project without their active direction, assistance, cooperation, and encouragement.

My supervisor, Associate Professor Dr. Mahfuza Parveen, PhD, provided me with diligent direction and encouragement to complete my assignment, for which I am eternally grateful. For their support, hard work, and direction throughout this journey, I am incredibly grateful to Professor & Head Dr. A.B.M. Kamal Pasha, PhD, Senior Lecturer Md. Azharul Haque Chowdhury, ESDM, DIU, Senior Lecturer Md. Sadril Islam Khan,ESDM, DIU, and all of their other colleagues. Last but not least, I want to express my gratitude to my senior Rime Shikder, closest friend Ishtiak Ifti; who either directly or indirectly assisted me in finishing this project report.

ABSTRACT

This article assesses the dairy industry in Bangladesh and ensures that milk is produced sustainably, nutrient-rich, and with the least possible negative environmental effects on the Buriganga River's neighbouring farms. The paper emphasizes the significance of putting best practices for waste management and milk production into practice to increase productivity while lowering environmental impact. Three dairy farms in Bangladesh were the subject of a scientific investigation and survey that examined the feeding practices, milk output, and sustainability of the farms while evaluating the effect of hay in the diet of dairy cows on the nutritional content of milk. According to the study, the amount of hay consumed directly affected the nutritional value of the milk, and all three farms had effective and long-lasting waste management systems. Milk quality could be enhanced in certain categories, like lactic acid concentrations, moisture concentrations, and fat percentages. The study finds that in order to produce high-quality milk while encouraging sustainability and environmental responsibility, dairy farmers must uphold proper feeding practices, waste management methods, and hygiene requirements for milking.

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Chapter 1: Introduction

1.1. Introduction

The growth of Bangladesh's dairy sector depends on nutrient importance and sustainable dairy milk production. This is because nutrient importance ensures that the milk produced is of good quality and can meet the nutritional demands of customers, while sustainable production ensures that the sector can continue to grow without harming the environment. Bangladesh is a developing nation with a large population. With a population density of 1278 persons per square kilometer, it has one of the highest densities of people in the world (worldometers.info, 2023). The Buriganga River serves as Dhaka City's main transit artery, source of drinking water, recreational area, flood control system, and drainage canal. It is crucial to the economic growth of Dhaka City. However, Dhaka City's fast unplanned urbanization, pressure from industry, and population increase negatively impact the environment, the Buriganga River's ecosystem, and pollutant transport. (Alam, 2008). Due to the economic and nutritional advantages of dairy production, it is regarded as a significant societal asset worldwide. The total amount of milk produced worldwide in 2019 was 851.8 million tons in milk equivalents (FAO, 2022). The expected amount of milk produced in Bangladesh in 2019 is 10.47 million tons. Bangladesh will need at least another 10 years to achieve independence, according to forecasts of the demand for milk production. According to the forecast, milk production will be 18.1 million tons in 2030, while consumption would increase by 17.22 million tons (Shahadat Hossain, 2022). For the past ten years, the business has expanded significantly and doesn't appear to be slowing down. The vicinity of Dhaka, Bangladesh's capital city, is one area where dairy farming has experienced tremendous expansion (Datta, 2018). Nutrient profile of vegetation has been widely distributed in the environment as a result of rapid industrialization, urbanization, and numerous anthropological activities (Md. Shakil Ahmed, 2019). The link between the nutrients in plants and the soil's nutritional status has been the main topic of discussion up to this point. This results from the fact that all plant material used as animal feed, including grass, wheat, and other kinds of plants, is cultivated in the soil. (Eric C. Brevik, 2012). However, the nutritional value of milk produced for human consumption is also influenced by the soil's nutrient status (Eric C. Brevik, 2012). Bangladeshi consumers are becoming more concerned about the quality and safety of their food, and they are willing to pay more for milk and dairy products that are produced environmentally and adhere to strict nutritional recommendations. Consumer health depends on milk that maintains a consistent nutritious profile. Nutrients, protein, acids, fat and B12, and other vital minerals can all be found in milk. Yet, differences in milk's nutrient profiles might happen because of things like cow breed, feeding habits, and processing and storage techniques. In especially for sensitive populations like toddlers and pregnant women, ensuring that milk provides a consistent and appropriate nutrient profile will help prevent deficits and support optimal health outcomes (Pereira, 2014). Components of sustainable dairy production include waste management and the nutritional composition of milk. To minimize the contaminating of soil, water, and air as well as to minimize the environmental impact of dairy production, proper waste management is essential. The nutrient composition of milk is very significant for consumers' health and wellbeing (Milk and Milk Products, 2019). Because customers are increasingly prepared to pay more for milk with higher nutritional value, improving the nutrient profile of milk may also have economic advantages for farmers (FAO., 2013). In many nations throughout the world, dairy farming is a vital industry that has a big impact on the food supply, the agricultural sector, and the economy. Yet, the practice also plays a part in environmental problems, especially when it comes to the management of wastewater and dairy wastes. There are many environmental risks associated with dairy farms' inadequate and poorly designed sewerage systems, including water pollution, greenhouse gas emissions, air pollution, and the spread of dangerous bacteria and diseases. Dairy farms' poorly designed and maintained sewage systems can pose a number of environmental problems. Secondly, inappropriate disposal of dairy wastes and wastewater can contaminate local water sources, causing water pollution and the spread of diseases that are transferred by water (Dickin, 2016). It has been observed that Bangladeshi dairy farming has significant environmental effects. According to studies, the production and disposal of waste, as well as the extensive use of water for cooling, washing, and irrigation, can cause water contamination and add to the problem of water scarcity (A.K.Shamsuddoha, 2000). Water contamination is one of the biggest environmental problems associated with poorly planned and executed sewerage systems in dairy farms. High quantities of organic matter and nutrients like nitrogen and phosphorus found in dairy wastes can contribute to eutrophication in aquatic environments. When there are too many nutrients in the water, algae and other aquatic plants overgrow, which depletes the oxygen in the water and kills fish and other aquatic species, eutrophication occurs. Moreover, dairy wastes may contain pathogens like Salmonella, Escherichia coli, and Cryptosporidium that can persist in water sources and infect both humans and animals with waterborne diseases (Duncan Mara, 2010). In Bangladesh, the dairy industry discharges massive amounts of wastewater outside. Hazardous chemicals that are abundant in dairy wastewater can result in a number of health issues (Rezwana, 2022). Greenhouse gas emissions are a further environmental risk connected to poorly planned and put in sewerage systems in dairy farms. Dairy waste breaks down under anaerobic circumstances, releasing methane, a strong greenhouse gas that accelerates global warming. Throughout a century, methane has a potential for 28 times more global warming than carbon dioxide (EPA, 2021). As a result, methane emissions from dairy farms may have a big impact on climate change. Thus, it is important to develop and implement effective and efficient management measures to reduce the negative effects of dairy farming on the environment. These tactics may involve the employment of reducing technologies as well as the implementation of best management practices, such as efficient waste disposal and nutrient management. Dairy farmers may help make the dairy industry more environmentally friendly and sustainable by putting these measures into practice and reducing the environmental risks connected to their businesses. Thus, waste management techniques should be added into sustainable dairy farming operations in order to mitigate their negative effects on the environment. This study aims to assess the raw milk production quality and sustainability of dairy farms along the Buriganga river. In addition to informing plans for increasing the quality and sustainability of the milk produced by dairy farms, the study will offer informative information about the factors that affect both. The results of the study will assist in the development of evidence-based strategies and actions that improve the sustainability of Bangladesh's dairy industry.

1.2. Objectives:

1. Assessing the ecological ramifications of pollution on the dairy industry's primary product, raw milk.
2. Analyzing the impact of dairy waste on the environment and waste management practices employed by dairy farms situated in close proximity to the Buriganga river

Chapter 2: Literature Review

2.1. Literature Review

One of Bangladesh's most essential consideration, dairy farming contributes a significant economic contribution to the country. Yet, the uncontrolled release of untreated effluent from dairy farms has a negative impact on the environment and the general public's health. The purpose of this review of the literature is to investigate the average nutritious composition of raw milk from dairy farms in Bangladesh and the waste management strategies.

Number	Title	Area	Description	Reference
1.	Assessment of milk quality and risk factors of mastitis in dairy cows in	Pemba Island Zanzibar, Tanzania	In this cross-sectional study, dairy cows in Tanzania were evaluated for their milk quality and mastitis risk factors. According to the study, poor hygienic habits and ineffective milking methods contributed to the high prevalence of mastitis and the low quality of the milk.	(Gwandu, 2018)
2.	Prevalence and antibiotic susceptibility pattern of Staphylococcus aureus isolated from milk samples of lactating cows in Bangladesh	Mymensingh district in Bangladesh	The prevalence and antibiotic susceptibility profile of Staphylococcus aureus, which was isolated from milk samples from nursing cows in Bangladesh, were evaluated in this study. Staphylococcus aureus was identified in large numbers in milk	(Nahar, 2021)

			samples, and the isolates tested positive for resistance to a number of widely used antibiotics.	
3.	Physiochemical characteristics of various milk samples in a selected Dairy plant in Bangladesh	Shahjadpur, Bangladesh	The goal of the study was to assess the physiochemical quality of a sample of raw milk from a chosen dairy facility in Bangladesh. The analysis and comparison of several physiochemical characteristics of milk to Bangladesh Standard (BDS-1985) and WHO Standards. This study's main concerns include the quality of the raw milk and the detection of adulterants at the point of collection.	(Dev, 2012)
4.	Physicochemical characteristics of various milk samples available in Pakistan	Peshawar, Pakistan	The study compares the physicochemical properties of various types of liquid milk sold commercially in Pakistan with those of fresh, raw animal milk. In Peshawar, Pakistan, milk samples were gathered from local	(Imran, 2008)

			markets and examined for their physical characteristics, including moisture, total solids, specific gravity, conductivity, viscosity, and titratable acidity (lactic acid equivalent), as well as their chemical constituents and macro-minerals, including total protein, casein, lactose, ash, and minerals.	
4.	Quality assessment of different commercial and local milk available in the local markets of selected area of Bangladesh	Mymensingh, Bangladesh	The objective of this study was to evaluate the physico-chemical, microbiological, and organoleptic quality of several commercial and local milk samples, as well as the presence of any adulterants. According to physico-chemical analysis, raw milk had the highest moisture content (90.68%), while UHT had the lowest (87.60%). Other components included ash (0.68%-0.78%), protein (3.20%-3.58%), fat (3.15%-3.56%), lactose (4.35%-	(Karmaker, 2020)

			4.62%), acidity (0.14%-0.22%), solid not fat (6.17%-8.95% total solid), and specific gravity (1.026-1.034%). For unprocessed samples, every adulteration test produced negative results.	
5.	Milk Production Trends and Dairy Development in Bangladesh	Bangladesh	This study characterizes Bangladesh's dairy production systems, provides updated information on significant changes in the dairy industry, and analyzes their effects on other South Asian nations. Similar to other South Asian nations, Bangladesh has a small-scale dairy system that is integrated with agriculture as well as other agricultural activities. Dairy farming provides strong prospects for farm families as well as non-farm rural and urban employment, and it is regarded as a significant	(Uddin, 2011)

			source of nutrition and revenue.	
7.	Poultry Industry's Contribution to Greenhouse Gas Emissions	United States	On a local, regional, and global level, climate change has the potential to have a negative impact on agricultural productivity. The environment, national and international markets, prices for food, fiber, and energy, agricultural incomes, and extreme weather events (such as drought and high temperatures) will all be impacted by altered rainfall patterns, increased occurrences of these events, changing pest pressure, and altered seasonal and diurnal temperature patterns. According to the EPA's estimation, 9.6% of all GHG emissions in the United States in 2019 were attributable to the agricultural sector. In comparison to other industries and areas like	(Tabler, 2019)

			transportation, this is a minor fraction.	

Table 1: Literature Review

Chapter 3: Methodologies

3.1. Methodologies

The procedure or way of conducting any form of study is known as methodology. Before conducting any research, the researchers must decide on a unique or authentic method of doing their task. Researchers anticipate having since the format of the study process has a direct impact on the result. As a result, it is crucial in the analysis of a research collection. A researcher presents their research methodology based on the subject. After conceptualization and literature review the methodology diagram will look like the given one hereby, All the elemental testing then combined and result will be calculated.

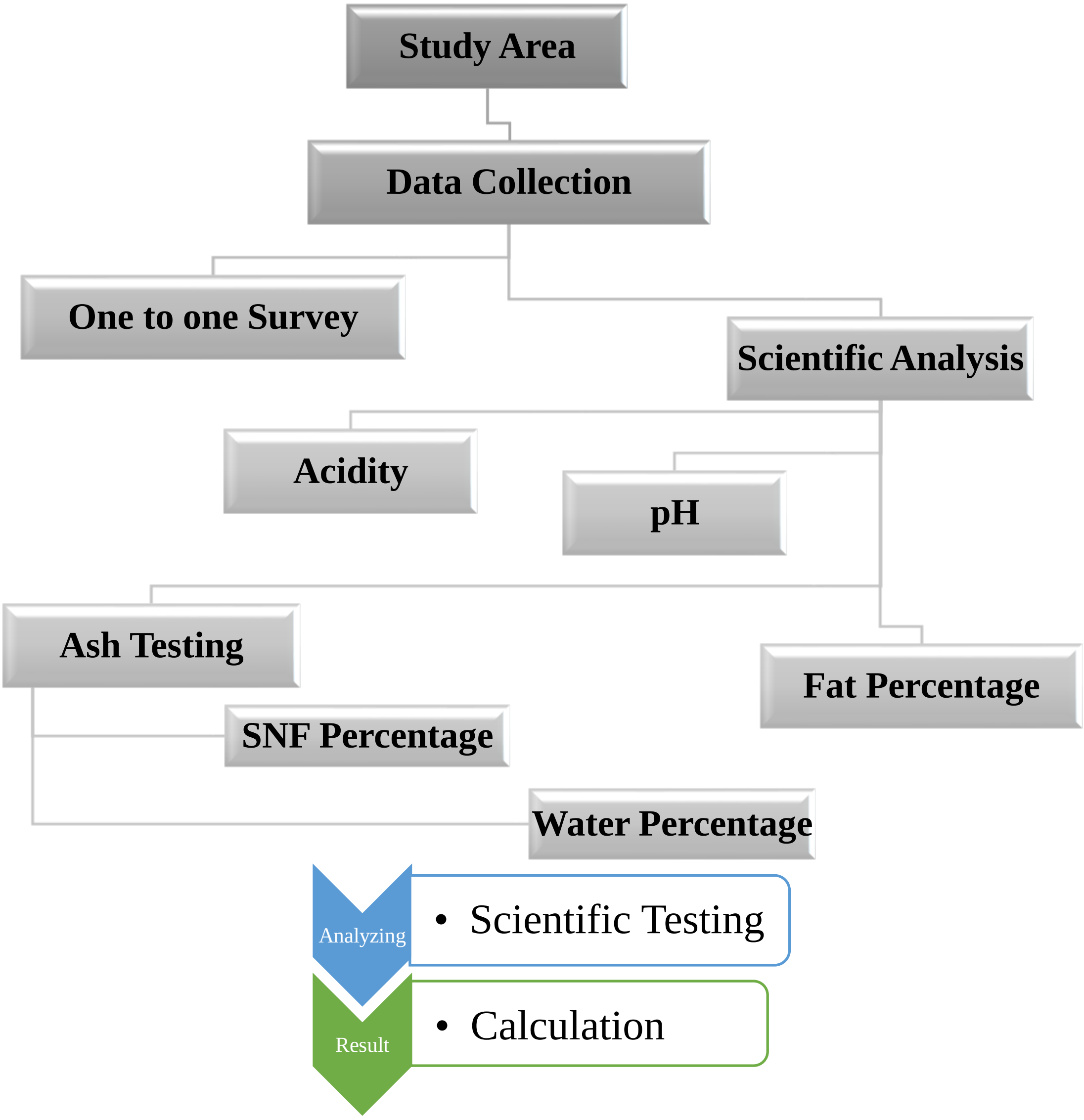

Figure 1: Methodology layers

3.2. Study Area

The three separate dairy farms in Kholamara, Dhaka, which are close to the Buriganga, were chosen as the subject of this thesis. The individual latitudes and longitudes of these 3 farms are,

Name	Latitudes	Longitudes
Masha-Allah cattle agro	**23°43'11.57"N**	**23°43'11.57"N**
Alom Dairy Farm	**23°42'54.87"N**	**90°21'27.71"E**
Sabuj Dairy Farm	**23°42'39.56"N**	**90°21'34.52"E**

Table 2: Farm Location (Latitudes & Longitudes)

Yet, a study area is the first step in every research project. This means that before conducting research, a research area must be chosen. For the research these 3 Dairy farms have been chosen. The map of the area is shown below,

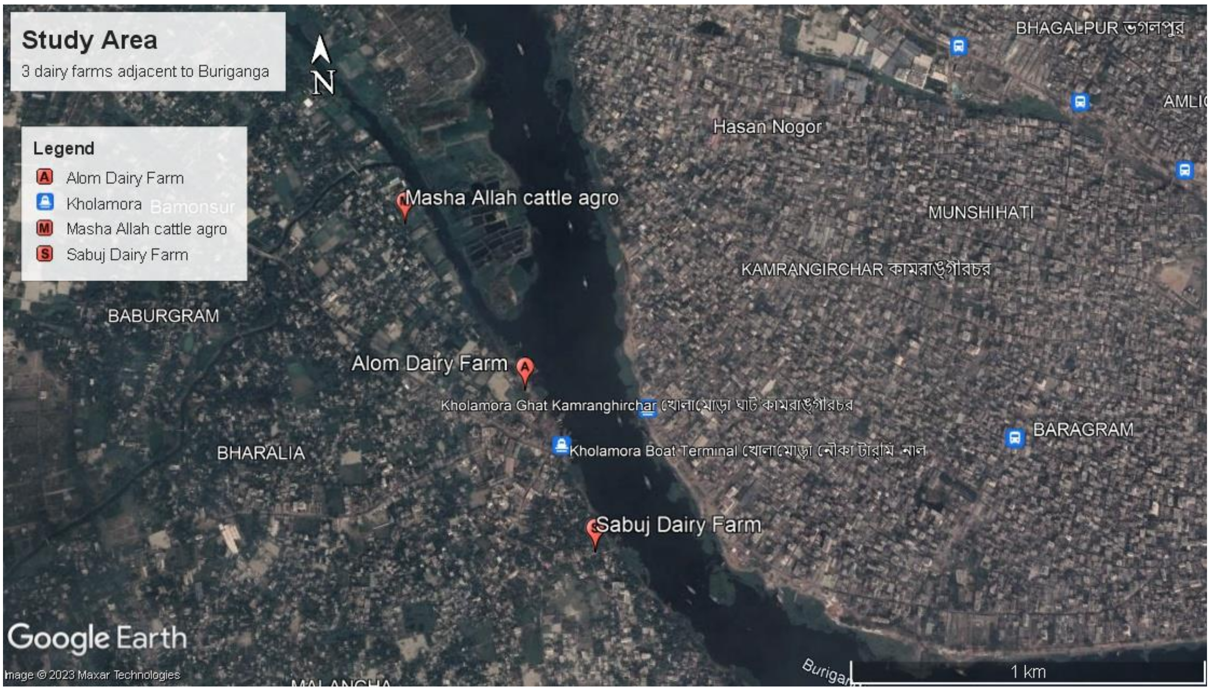

Figure 2: Study Area Map by Google Earth

3.3. Data Collection Method:

The work of gathering all of the data required to achieve the objectives is essential after setting the goals and having a clear understanding of the study area. The conclusion of a visitor totally depends on the information gathered for this reason. Both Laboratory testing and One to One qualitative survey are used in the data collection.

3.4. Milk Sample Collection:

The milk sample can be retrieved using a variety of techniques. When the cows had been milked for the evening, samples were taken from three different farms. Customers collect their necessary amount of milk from a single huge surfaced container that contains the entire amount. Each dairy farm provided a minimal 500 ml sample of milk, which was then collected in an airtight plastic bottle and accurately marked.

Figure 3: Milk Sampling

Figure 4: Milk Collection

3.5. One-to-One Survey interviews:

Researchers can get information or data directly from respondents by doing one-on-one interviews. It is a qualitative research technique that relies on the researcher's expertise to formulate and sequentially ask pertinent questions to elicit significant insights from the interview. Qualitative questionnaires were asked from the elected person of the Dairy farms where they stay and work 24/7.

Figure 5: One to One Interview

3.6. Photography Collection:

In order to show the situation of the study region, etc., numerous images were also required. Several of these images were taken out there in the field.

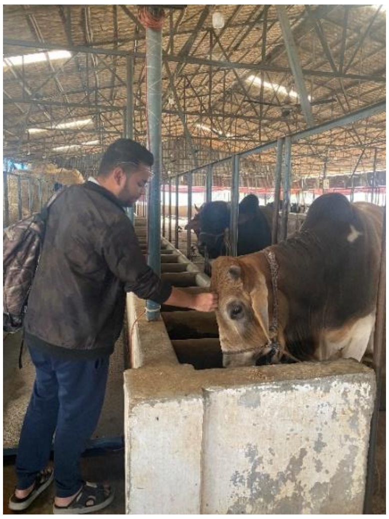

Figure 6, Figure 7, Figure 8: Farm Visiting & photographic collection

3.7. Scientific Analysis:

3.7.1. Measuring the pH of milk:

pH measurements are frequently used as milk acceptability tests. The word pH is short for hydrogen weight. S.P.L. SOrensen, a Danish scientist, coined this phrase in 1909. (1868-1939). The definition of pH value is the negative common logarithm of the active hydrogen ion concentration in an aqueous solution since the pH scale covers the active concentration of the H+ ions and OH- ions. The pH values for neutral, acidity, and alkalinity are, respectively, 7, less than 7, and more than 7.

Many steps have been made to precisely assess the pH of milk. To ensure accuracy, the pH meter has first been calibrated. The electrode was then placed into the milk and kept there for a minute to allow the reading to stabilize. The values from the three milk samples were then recorded and compared to the ideal range for milk, which is 6.5 to 6.8 (YINGQUN NIAN).

Figure 9: pH Testing

Figure 10: pH meter

3.7.2. Acidity Test:

Step 1: Chemical preparation (FOX, 1998)

- Sodium hydroxide solution was prepared by dissolving 4g of sodium hydroxide pellets into 900ml of distilled water and making a final volume of 1000ml. The solution was cooled and standardized before use.

Step 2: Determination of Density

- A 50ml measuring cylinder was filled with the milk sample.
- A calibrated thermometer was inserted into the sample, and the temperature of the sample was measured.
- The thermometer reading was found to be 27°C and was noted.
- A lactometer was brought and sunk into the sample to float freely.
- The lactometer reading was observed to be more than 25, and the lactometer was rotated to see every mark on the lactometer scale clearly.

- The lactometer reading was taken, considering just above the surface of the milk, and was found to be 27°C. The reading was noted.

Step 3: Sample preparation

- 10ml of the milk sample was taken into a clean and dried conical flask.
- 10ml of distilled water was pipetted and poured into the flask.
- The flask was shaken to mix the milk sample with water.

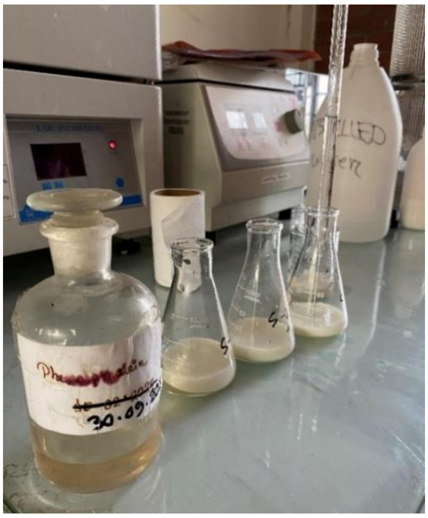

Figure 11: Titration Sample

Step 4: Titration

- 2/3 drops of phenolphthalein indicator solution were added into the flask.
- 0.1N Sodium Hydroxide Solution was taken in a burette, and the initial burette reading was noted.
- Titration was started by liberating 0.1N sodium hydroxide from the burette.
- The titration was stopped when the solution color changed into light pink, and the final burette reading was noted.

Step 5: Calculation

- The volume of sodium hydroxide used for titration was calculated by subtracting the initial burette reading from the final burette reading.
- The titratable acidity of the milk sample was calculated using the following formula: Titre value x Normality of NaOH x 100 / Sample volume (ml)
- The result was expressed in terms of percentage lactic acid.

Figure 12: Sample 1 Titration

Figure 13: Sample 2 preparation

3.7.2. Total solid & solid-non-fat Test:

To determine the total solid and solid non-fat content (FOX, 1998) in milk, the following steps are taken:

Step 1:

• A flat-bottomed porcelain crucible or petri dish is taken and cleaned and dried in a hot air oven.

• The weight of the Petri dish is noted.

• 10g of milk sample is added to the dish, and its weight is noted.

• The dish is put in a hot air oven for 90 minutes at 110°C.

• The dish is removed from the oven and cooled in a desiccator.

• The weight of the dish and the dried milk sample is noted.

Once the dry weight is obtained, the percent moisture content is calculated using the formula:

% of moisture content = Ws-(w2-w1)/Ws

Step 2:

• 10.75ml of milk is taken in a butyrometer tube.

• 10ml of Gerber sulphuric acid and 5ml of iso-amyl alcohol are added to the tube.

• The tube is closed with a lid and rotated to mix the contents.

• The tube is heated in a hot water bath at 65°C for 5 minutes.

• The tube is centrifuged for 5 minutes at 1100rpm.

• The milk fat percentage is read from the label on the butyrometer.

Step 3:

• The total solid percentage is calculated using the formula:

Total solid%= Total solid%- total moisture%

• The solid non-fat percentage is calculated using the formula:

S.N.F% = Total solid%- fat%

Figure 14: Milk Measuring

Figure 15: Oven Dry sample

3.7.3. Determination of fat in milk by Gerber method:

The traditional standard reference method for fat analysis is based on either weight or volumetric determination. There are many analytical methods for the determination of the fat content of milk; the Gerber test is widely used all over the world (BSI, 1989).

Steps:

- Transferring 10 ml of sulphuric acid into the butyrometer using the 10 ml acid pipette.
- Filling the 10.75 ml pipette with milk and delivering the sample into the butyrometer.
- Adding 1 ml of amyl alcohol using the 1 ml pipette and closing the butyrometer. Shaking it in the shaker stand until no white particles are seen and inverting it a few times.
- Placing the butyrometer in the water bath at 65 degrees for 5 minutes.
- Taking the butyrometer out and drying it with a cloth, then putting it in the centrifuge and centrifuging at maximum speed for 4 minutes while placing two butyrometers diametrically opposite each other.
- Transferring the butyrometers, stoppers downwards, into the water bath for 3-10 minutes.

Figure 16: Centrifuge Machine

Figure 17: Water Bath

- Bringing the lower end of the fat column onto a main graduation mark by slightly withdrawing the stopper and checking that:

  - the colour of the fat is straw yellow,
  - the ends of the fat column are clear and sharply defined,
  - the fat column is free from specks and sediment,
  - the water just below the fat column is perfectly clear,
  - the fat is within the graduation.

Result: Fat ………. %

Chapter 4: Result and Discussion

4.1. Elemental Testing Result

The findings and outcomes of our experiment are broadly discussed in the chapter in a distinct format. We worked toward six different objectives when we first started this research study project. By examining the data and findings in various ways, we attempted to gain a clear grasp of the objectives in this chapter.

4.1.1. pH Result:

One of the most essential factors in determining milk quality is pH because it has an impact on the product's physical characteristics, enzyme activity, and microbial growth. In this study, we measured the pH of three samples of milk and compared it to the reference value. With sample 2 having the highest pH of 6.62 and sample 1 having the lowest pH of 6.23, the results showed that all three samples had a pH that was within the desirable range of 6.5-6.7. (YINGQUN NIAN) (Bennett, 2013) According to these findings, the milk samples are of high quality and safe for consumption. (INDIA, 2016)

4.1.2. Lactic Acidity Result:

Lactic acid, a naturally occurring by-product of milk fermentation, is a significant factor in the nutritional value and freshness of milk. In this study, three milk samples underwent a lactic acid test to ascertain their lactic acid levels and compare them to the typical lactic acid level in milk.

Three separate milk samples were used for the lactic acidity test, and the findings were sample 1, sample 2, and sample 3: 0.33%, 0.21%, and 0.19%, respectively. It can be shown that all three samples have greater lactic acid levels than the typical value based on the standard lactic acid level of milk, which is between 0.15% and 0.18%

The United States Department of Agriculture states that the maximum permitted level of lactic acid in milk is 0.22%. As a result, Sample 1 had lactic acid levels that were much higher than the permitted limit, as opposed to Samples 2 and 3, which had levels that were only marginally above the limit. ((USDA), 2020)

The greater amounts of lactic acid in the milk samples may not be good for the milk's shelf life or appropriateness for some dairy products. This shows that an increase in lactic acid levels was caused by contamination or spoiling of the milk samples. (Services, 2017) To

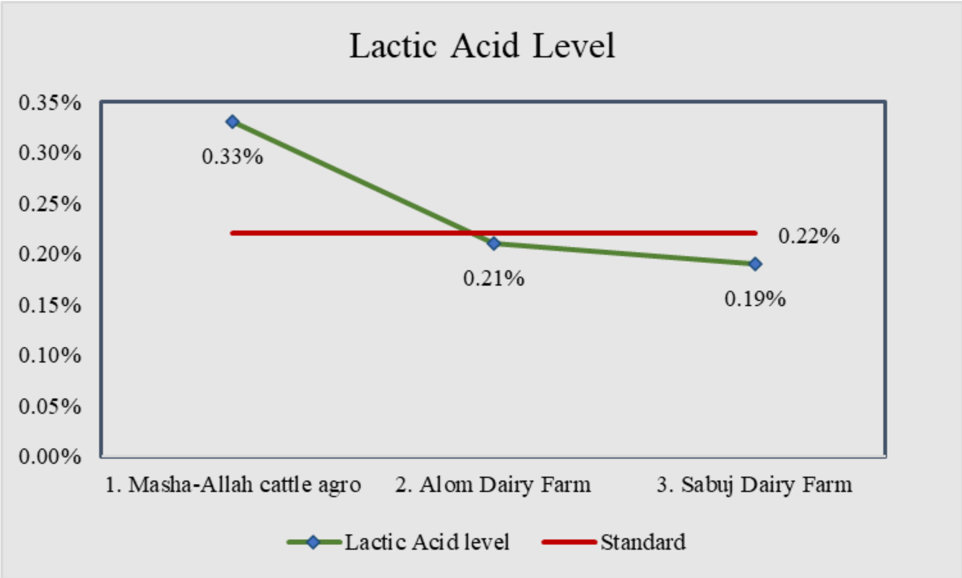

Figure 18: Lactic Acid Level graph

ascertain the reason for elevated lactic acid levels in the milk samples, more research and analysis are necessary (CHARLESG.L.WOLF.). Also, it is significant to remember that the lactic acid test, which is frequently used by dairy farmers and milk processing facilities to evaluate the quality of their products, gives information about the quality and freshness of milk (Lajnaf, 2022). To ensure the safety and quality of dairy products for consumers, it is essential to make sure that the lactic acid levels in milk are within the normal range (Dipendra Kumar Mahato, 2020).

4.1.3. Milk Fat Testing:

Three milk samples were examined for their fatty acid composition; the results showed that the percentages were 4.7%, 4.5%, and 3.5%, respectively. The samples 1 and 2 were found to be slightly higher than the standard value, while sample 3 was lower. The average milk fat content is roughly 3.5%. These differences could be explained by a number of variables, including the breed, age, and food of the cows, as well as the processing and storage techniques (Welfare, 2017). To ensure the milk's quality and nutritional content, the fat percentage must be kept within the acceptable range (FAO, 2022).

While the lower fat concentration in sample 3 may be an issue for items that need a certain level of fat, the higher fat content in samples 1 and 2 may be advantageous for some dairy products. The particular causes that caused the variances in the fat percentages of the milk samples may be identified with more investigation and testing (Amy Logan1, 2019). For milk quality monitoring and regulation, it is essential to maintain testing procedures' accuracy and uniformity (Debashree Roy, 2020).

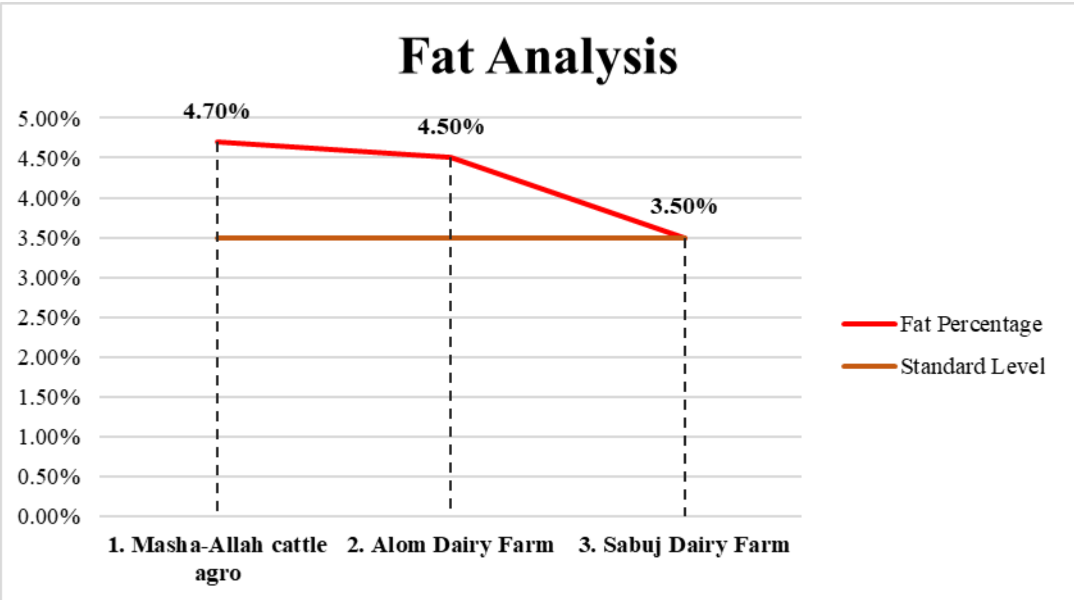

Figure 19: Fat Analysis graph

4.1.4. Moisture Content Analysis Result:

Three different samples were analyzed in order to determine the milk moisture content, which had values of 60%, 66%, and 75%. These values were acquired by following the right sampling techniques (FAO, 2022). For milk moisture percentage, the International Dairy Foods Association (IDFA) suggests a standard value of 85% (Association, 2019) It is clear that the three samples don't meet this minimum requirement. The samples' measured standard deviation is 7.35 percent, which suggests that they are not closely clustered around the mean (Bremner, 2013). This could be caused by a number of things, including differences in the content of the milk, processing, storage, and sample methods (FAO, 2022), (Association, 2019).

It is important to take into account that milk moisture content impacts the quality and shelf life of dairy products, making it a crucial factor in the dairy business (G. Butler, 2011). The samples' test findings indicate that they might not be acceptable for consumption or further processing. To determine the causes of the variations and to make sure that the samples' milk moisture percentage complies with the IDFA standard value, more research is required. In conclusion, the three samples may not be of the appropriate quality because the milk moisture percentage is lower than the IDFA standard value.

4.1.5. Solid-Non-Fat Result:

The percentages of SNF (Solid Not Fat) in the milk samples examined in this study (samples 1 and 2 were 35%, 34%, and 21.5%, separately), were compared to the benchmark level established by the International Dairy Foods Association (IDFA). Cow's milk SNF percentages must meet IDFA standards, which range from 8.6% to 10.0% (Association, 2019).

All three samples in this study had SNF percentages that were much greater than the IDFA standard level, according to the study's findings. The greater SNF percentages in the samples could be attributable to a number of things, including the type of cows, the way they were fed, and the environment (U. Ruth Charrondière, 2013).

The SNF percentages of the milk samples examined in this study were, in conclusion, significantly higher than the IDFA standard level, suggesting that additional research is required to ascertain the root reasons of these variations and to create plans to enhance milk quality (Joseph V. Balagtas, 2007).

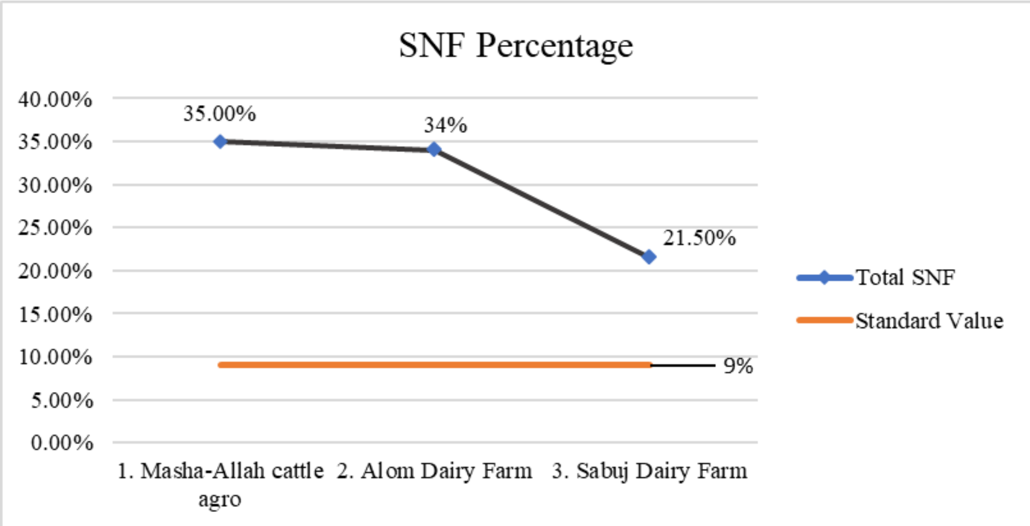

Figure 20: SNF Percentage graph

Farm	Lactic Acid level	Moisture Content	Fat Percentage	Total SNF	pH
1. Masha-Allah cattle agro	0.33%	60%	4.70%	35%	6.23
2. Alom Dairy Farm	0.21%	66%	4.50%	34%	6.62
3. Sabuj Dairy Farm	0.19%	75%	3.50%	21.50%	6.32
Standard Value	0.22%	87%	3.50%	9%	6.5-6.7

Table 3: Scientific Testing result of milk sample of 3 farms with standard value

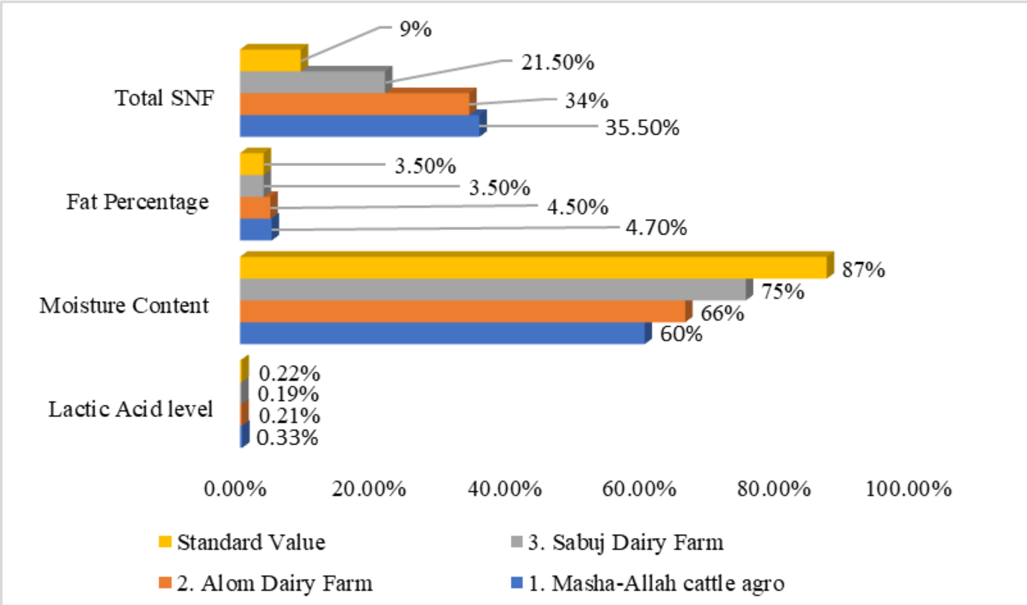

Figure 21: Bar Chart (comparison with standard values)

Masha-Allah Cattle Agro has the highest level of lactic acid, at 0.33%, which is higher than the industry average of 0.22% ((USDA), 2020). This suggests that this farm's milk has more fermentation than the milk from the other farms. While a certain amount of lactic acid aids in digestion, excessive amounts can cause milk to taste sour and unappealing. This can be the result of improper milk handling or feeding procedures, which could have an adverse effect on the farm's environment (Pak, 1995). The maximum moisture content was recorded at Sabuj Dairy Farm (75%), which is significantly higher than the average of 87% (Association, 2019). This suggests that the water content of the milk from this farm is higher, which could dilute the milk and lessen its nutritious value. Moreover, a high moisture content might cause bacterial growth and milk deterioration. This can be the result of improper storage procedures or milking hygiene, both of which could have an adverse effect on the farm's environment (WHO WORLD HEALTH ORGANIZATION, 2011). The farm with the highest fat percentage is Masha-Allah Cattle Agro, at 4.70%, which is greater than the average for the industry of 3.50% (FAO, 2022). This suggests that the milk from this farm is higher in fat, which some consumers may find appealing. Yet, a high fat diet can also increase your risk of heart disease and other illnesses (Americans, 2015-2020). The farm with the largest total SNF, Masha-Allah Cattle Agro, has a 35% value, which is above the standard of 9% (Association, 2019). This suggests that the farm's milk contains a larger amount of nutrients and solids. However, it's crucial to remember that excessive amounts of solids-without-fat can also hasten deterioration and bacterial development. Also, it may result in environmental problems like water pollution from dairy waste (Zahra, 2021). In order to maintain the quality and safety of their products, dairy farms must maintain sustainable levels of dietary components. Excessive amounts of fat and solids-not-fat, as well as lactic acid levels and moisture content, can be harmful to the environment and to consumer health. To produce high-quality milk with the fewest negative effects on the environment, dairy farmers should put appropriate milking hygiene, feeding techniques, and storage systems first.

4.2. One to One survey outcome:

Milk, cheese, butter, and other dairy products are all produced via dairy farming, which is a crucial aspect of agriculture. In this survey report, we'll examine three dairy farms' milk output as well as the feeding procedures that have an impact on it.

- The average amount of milk produced daily by Farm 1's 91 cows is 300 litters. On the farm, hay makes about 75% of the diet, along with a variety of supplementary feeds.
- The average amount of milk produced daily by Farm 2's 67 cows is 280 litters. 70% of the food is provided by the farm, along with a variety of supplementary feeds.
- The average amount of milk produced daily by Farm 3's 93 cows is 320 litters. 60% of the food is provided by the farm, along with a variety of supplementary feeds.
- Two times a day, in the morning and evening, the cows are milked.

Farm	Milk Production	Hay percentage
1. Masha-Allah cattle agro	300 L	75%
2. Alom Dairy Farm	280 L	70%
3. Sabuj Dairy Farm	320 L	60%

Table 4: Milk Production & Hay feeding percentage of total diet of 3 Farms

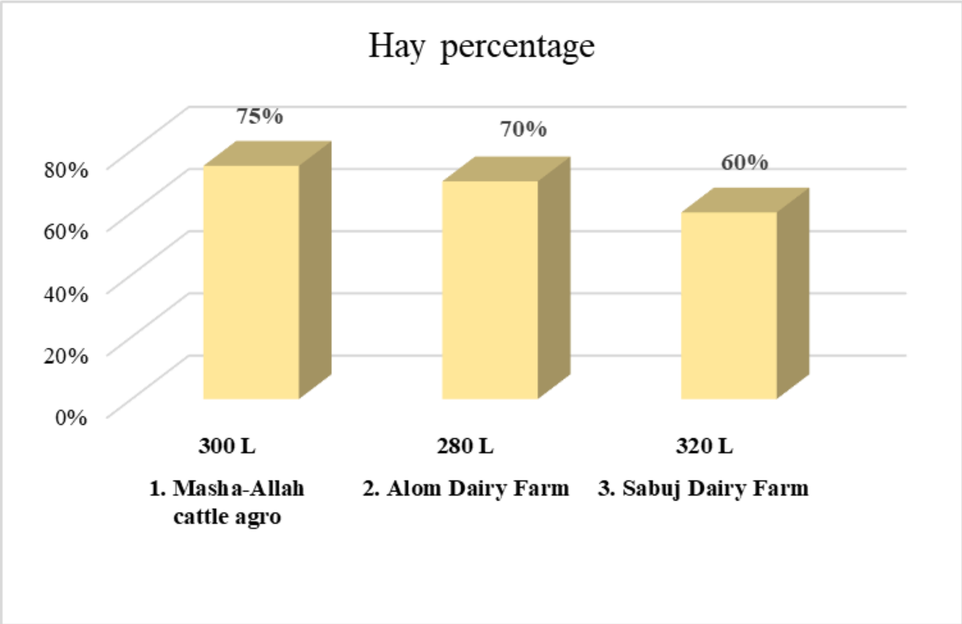

Figure 22: Bar Diagram (Milk production comparison with Hay%)

The waste management system and wastewater lines at Masha-Allah Cattle Agro, Alom Dairy Farm, and Sabuj Dairy Farm were reviewed as part of the one-to-one survey. The purpose of the survey was to evaluate the waste disposal system's efficiency, sustainability, and compliance with national and international standards.

The survey's findings showed that each of the three dairy farms had a thoughtfully designed system for disposing of waste, with wastewater lines joining the primary disposal line. The Bangladesh Standards and Testing Institution (BSTI, 2011) and the Global Sustainable Agricultural Standards (GSAS) assessed the waste disposal system to be effective and sustainable (Soyer, 2020). The biogas plant at Alom Dairy Farm (Farm 2) used cow excrement to create biogas, which was then used for heating and lighting functions on the farm. Local nursery operators use cow manure from Masha-Allah (Farm 1) and Sabuj Dairy Farm (Farm 3) to make compost fertilizer.

Several Sustainable Development Goals (SDGs) are connected to the waste management system on dairy farms and milk quality certification, including:

SDG 2: Zero Hunger - People all throughout the world rely on dairy products for nutrition. Effective management of dairy farm waste helps lessen the dairy industry's negative environmental effects and guarantee the sustainable production of high-quality milk, which can assist to increase food security and nutrition.

Good Health and Well-Being, SDG 3 The safety and quality of milk products, which are crucial for maintaining good health and preventing diseases, can be helped by using the right milk quality assurance procedures. The detrimental effects of pollution and environmental deterioration on human health can be lessened with the use of efficient waste management systems.

SDG 6: Clean Water and Sanitation - Because of the discharge of animal waste and other pollutants, the dairy industry has the potential to significantly affect water quality. Access to clean, safe water can be ensured by using proper waste management procedures.

SDG 12: Responsible Consumption and Production - Achieving responsible consumption and production requires sustainable dairy farm waste management and milk quality assurance measures. This entails lowering waste, increasing resource effectiveness, and making sure that dairy products are produced and consumed sustainably.

SDG 13: Climate Action - Dairy farming waste can cause air and water pollution, and the dairy industry contributes significantly to greenhouse gas emissions. Effective waste management techniques can lessen industry's negative environmental effects and slow down climate change.

Overall, the SDGs for health, nutrition, environmental protection, and sustainable development all depend on the dairy farm waste management system and milk quality certification.

In conclusion, the survey finds that the three farms produce varying amounts of milk, which are influenced by a variety of variables including feeding procedures and milking schedules. Farm 1 (Masha-Allah Cattle Agro) offers a diet that is 75% hay, Farm 2 (Alom Dairy Farm) offers a diet that is 70% hay, and Farm 3 (Sabuj Dairy Farm) offers a diet that is 60% hay. The cows on all three farms are milked twice a day, in the morning and in the evening. The most milk is produced at Farm 3, then Farm 1 and Farm 2, respectively. Farmers should think about implementing best practices including offering a balanced diet, employing artificial insemination, and spend on skilled worker if they want to enhance milk output. Overall, the survey's findings showed that Masha-Allah Cattle Agro, Alom Dairy Farm, and Sabuj Dairy Farm's waste disposal system and wastewater lines were well-planned, effective, and sustainable. The farms ensure that their waste disposal methods were both environmentally and socially responsible by adhering to the requirements established by the BSTI and GSAS. The findings also emphasized the significance of having a thorough waste management strategy in place, as this can assist farms in minimizing their environmental effect and maximizing their productivity

4.5. Correlation

Farm	Hay percentage	Lactic Acid level	Moisture Content	Fat Percentage	Total SNF
1. Masha-Allah cattle agro	75%	0.33%	60%	4.70%	35.50%
2. Alom Dairy Farm	70%	0.21%	66%	4.50%	34%
3. Sabuj Dairy Farm	60%	0.19%	75%	3.50%	21.50%
	Correlation	0.83576610	-0.99717646	0.984324138	0.9723406

Table 5: Correlation with Hay% and 4 other elements (Lactic Acid level, Moisture Content, Fat Percentage, Total SNF)

The data provided indicates that there is a significant correlation between the hay Percentages and other variables in the three dairy farms.

Hay percentage and lactic acid level have a 0.84 correlation value, which indicates a somewhat good link. This implies that the lactic acid level grows along with the amount of hay in the meal. This is understandable given that hay contains fermentable carbohydrates, which the ruminant bacteria use to make lactic acid as a by-product. Hay percentage and moisture content have a high negative correlation, as indicated by the correlation value of -0.99. This implies that the moisture content of the feed falls as the proportion of hay increases. This is to be expected because hay is a dry feed that loses moisture when it absorbs moisture in the ruminant.

Hay percentage and fat percentage have a 0.98 correlation coefficient, which indicates a very significant positive connection. This implies that as the amount of hay in the feed increases, so does the amount of fat. This is expected because hay contains fibre, which increases the synthesis of fat by stimulating the rumen's production of volatile fatty acids. Hay percentage and total SNF have a 0.97 correlation coefficient, which indicates a very significant positive link. This shows that the overall solid-not-fat (SNF) content grows along with the amount of hay in the meal. This is understandable given that hay is a source of energy that the cow uses to generate milk solids. These findings collectively imply that the nutritional composition of dairy cows' milk is significantly influenced by the amount of hay present in their meal. When creating diets for their cows, dairy farmers should take into account the amount of hay in the feed as well as other elements that have an impact on milk quality and production.

Chapter 5: Conclusion

5.1. Conclusion

Based on the results, it's possible to conclude that the amount of hay in a dairy cow's diet has a considerable impact on the nutritional content of the milk. The percentage of hay in the meal had a direct impact on the milk's levels of lactic acid, fat, and total SNF, according to the study. This suggests that the type and quantity of milk produced are significantly influenced by the diet of the cows. According on their feeding practices and milking schedules, Masha-Allah Cattle Agro, Alom Dairy Farm, and Sabuj Dairy Farm were put side by side in the study. According to the study, the three farms had different amounts of hay in their feed, with Farm 1 providing a diet that is 75% hay, Farm 2 providing a diet that is 70% hay, and Farm 3 providing a diet that is 60% hay. Two times a day, in the morning and in the evening, the cows on each of the three farms were milked. According to the study, Farm 3 produced the most milk, which was then followed by Farm 1 and Farm 2, respectively. The three farms' environmental effect, sustainability, and SDG compliance were also examined. The results demonstrated that all three farms had wastewater systems and waste disposal systems that complied with the standards set by the BSTI and GSAS. These systems were well-planned, efficient, and sustainable. This made guaranteed that their waste disposal practices were ethical in terms of both the environment and society. The study stressed the significance of putting in place an extensive waste management strategy because this can help farms reduce their environmental impact and increase their productivity. The study soon discovered, however, that there were some areas where the milk quality from the three farms might be enhanced. Masha-Allah Cow Agro, for instance, had the greatest concentration of lactic acid, which was higher than the industry standard. This implies that there may be more fermentation in the milk from this farm than in the milk from the other farms. The highest moisture concentration, which could thin the milk and reduce its nutritious value, was found at Sabuj Dairy Farm. Masha-Allah Cattle Agro had the largest fat percentage and total SNF, which may appeal to some customers but may also raise their risk of heart disease and other illnesses, according to the study. Environmental issues like water pollution from dairy waste can also arise from lactic acid levels and an abundance of solids-not-fat along with the health impact on consumers. Despite the fact that the study offers insightful information about the feeding practices, milk production, and sustainability practices of three dairy farms, it is important to note that due to time constraints and the access shortage of high demand scientific laboratories, a comprehensive and detailed analysis of the impact of pollution on milk could not be carried out. To produce high-quality milk with the fewest adverse consequences on the environment and consumer health, dairy farmers must maintain sustainable levels of dietary components. This calls for proper feeding practices, waste management techniques, and cleanliness standards for milking that promote sustainability and environmental responsibility.

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Daffodil Smart City, Ashulia, Dhaka

One to One Qualitative Survey on Physiochemical Characteristics of Raw Milk & Waste Management System Analysis of Dairy Farms Adjacent to Buriganga River

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Program B.Sc. (Hons) in Environmental Science& Disaster Management

Department Environmental Science & Disaster Management

Faculty of Science & Information Technology

General Information

1. Dairy Farm Name:
2. Farming Age:
3. Address:
4. Contact No:

Qualitative Questions:

1. What is the daily production amount of milk in your dairy farm?

2. How do you manage the feeding system of your cows?

3. What percentage of hay is included in the diet of your cows?

4. How do you manage the waste disposal system in your dairy farm?

5. Do you have any specific plan to ensure the environmental safety of waste management in your dairy farm?

6. What is the current status of wastewater treatment in your dairy farm?

7. How do you ensure that the wastewater does not contaminate the nearby river?

8. What steps have you taken to reduce the impact of dairy waste on the environment?

9. Have you ever faced any regulatory action for environmental violations related to your dairy farm?

10. What steps have you taken to improve the quality of your milk in terms of physio-chemical characteristics?

11. Do you think that the management of waste and environmental safety is important for sustainable dairy farming?

12. What is your opinion on the regulatory framework for waste management in the dairy industry?

13. Have you received any training or guidance on sustainable waste management practices in your dairy farm?

14. What is your view on the use of modern technologies for waste management in the dairy industry?

15. What do you think should be done to ensure better waste management and environmental safety in the dairy industry?

Figure 23: Cow feed (Hay)

Figure 24: Selling System

Figure 25: Fat Determination

Figure 26: Separated Fat