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The Impact of Farming Methods on Dairy Cow Milk Output on Tiny-Scale Farms: An Analysis

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Abstract

Dairy cow milk is a nourishing beverage produced from the lactating milk of breastfeeding cows and is recognized for having essential elements, including vitamins, calcium, and protein. It is the leading supplier of dairy products, supporting human nutrition and a wide range of culinary uses around the globe. Numerous dairy management strategies (DMSs) have been developed in response to the significant interest in the issue of raising milk yields (MYs) among tiny-scale dairy cow farmers (SDCFs). Adoption of these DMSs has yet to enhance MYs on-farm, and DMS performance varies among farms. This analysis generates data from several locations to examine the effects of different methods of farming on the milk production of dairy cows in small-scale farms. A comprehensive understanding of the patterns and trends in dairy cow milk data is accessible through the analysis of the data on the Enhanced Genetic Gains (EGP) initiatives 2016–2019. Climate problems, breeding and genetics, and feeding habits are significant factors that affect the yield of dairy cow milk at small-scale farms. The chi-square test is the statistical analysis technique used to evaluate the relationship or independence of specific variables in a dataset. Finally, a comprehensive analysis of the production of dairy cow milk on small-scale farms demonstrates the complex interactions among farming techniques, environmental conditions, and total productivity. Our outcomes imply that the most effective way to raise MYs on farms is to combine better feeding practices with better cow breeds.

Keywords: Lactating Milk, Enhanced Genetic Gains (EGP), Milk Yields (MY), Seasonality Chi-Square Test, Dairy Products

INTRODUCTION

Dairy products are foods high in nutrients that are essential for a balanced diet. These nutrients include calcium, potassium, protein, fat, and vitamin D. Dairy products and milk are the ideal side dish for a nutritious dinner and can lower the risk of osteoporosis, and cardiovascular disease (1). Dairy products are known for having limited options for storingtheir inventories, making them unstable and challenging to transport and store. Since milk is anunstable commodity, it should be handled carefully, transported as soon as possible, andprocessed within 24 hours at a temperature as low as 4 °C. The number of bacteria grows, and the rate of milk metabolism quickens with time. In terms of food and drink consumption, dairy products rank second (2). The milk market is constantly changing on a worldwide scale. Customers, whose tastes in milk and processed dairy products are evolvingamong the most crucial links in the dairy marketing chain. The sector has faced challenges in diversifying its product line due to shifting consumer demands. Global dairy commerce has increased as a result of rising demand for dairy products in emerging economies (3). Increased milk yields and higher production efficiency, fewer small dairy farms, and larger dairy herds have contributed to the global growth in milk output. The growing trend of customers favoring soy and

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nut-based products over cow's milk exacerbates this dilemma. Reduced fertility of cows as a result of increased productivity and more animals per worker is a significant issue for milk production. To increase the profitability of dairy farms, new production methods are required, such as improvements in nutrition, genetics, and herd management (4). Milk is anutrient-dense. It serves as a young's primary source of nourishment until they can process other foods.Because of its composition, milk is the perfect substrate for the development of germs that can enter through the udder's interior, the animal's exterior, milk handling equipment, and other random sources like the air in the milking area (5). Because milk contains nutrition, germs that cause spoiling can multiply in it. Unsanitary production methods, careless handling, and unfavorable behaviors like adding water or other materials might introduce germs or bacteria that lead to spoiling.Many different bacteria can survive in milk due to its natural properties, and these germs could reach the milk during the milking, processing, storing, or market transportation processes (6). These microbes can have originated from the surrounding area, the milking parlor's equipment, the animals being milked, or the milkers themselves. Microorganisms can grow once they get into milk and alter its quality. In the event that pathogenic bacteria are present, they can harm consumers by infecting them with illnesses and ailments.Microorganism contamination of milk is unavoidable due to its unique manufacturing process (7). The main goal of producing milk from dairy cows is to give healthy, high-quality milk to people on a regular basis. To ensure that the milk produced by lactation cows contains vital elements like calcium, protein, and vitamins, dairy farming attempts to maximize the milk supply from these animals.

The study (8) focused on using test-day milk data to identify thresholds for heat stress, milk production loss, and individual animal differences for dairy cattle using random regression models. The Kenyan Cattle Breeders Organization provided statistics for the years 2000–2017, which were combined with meteorological information. The study (9) determined that high temperatures affected the amount of milk produced by dairy cows in southern Slovakia in 2015. Testing was done on the theories that cooling and altitude had an impact on milk production.The study (10) used information compiled from research on the eating habits of nursing dairy cows to find correlations between feeding behavior parameters and milk output. Their findings imply when cows were allowed to spend more time eating, meditating, and feeding, milk supply and manufacturing of components could increase.The study (11) aimed to evaluate the impact of inbreeding on the yield of milk from cows with varying genotypes. The majority of the herd, or 83.8%, was discovered and produced by distant inbreeding. The study (12) examined the AFM1 concentration of 868 samples of dairy products, pasteurized and Raw and UHT cow's milk available. The amount of milk and dairy consumed in Lebanon was assessed using an eating frequency questionnaire. As a result, exposure to AFM1 and its correlation with the risk of liver cancer in the Lebanese population was considered. The study (13) evaluated the rumen bacteria in nursing cows with varying milk protein yields in an effort to determine the function of gastrointestinal bacteria in this characteristic. Among 374 Holstein dairy cows in mid-lactation fed a high-grain diet, animals with high and low milk protein yields were chosen. The study (14) proved to record the effects of AMS adoption on farms in relation to reported modifications in milk output, milk quality, labor management during milking, and involvement in dairy herd development (DHI) initiatives.The study (15) aimed to determine the composition of several individual milk samples was affected by differences in somatic cell count. The variation in somatic cell count increased with higher milk quality, according to the results. More specifically, it was shown that when the variation in somatic cell count level increased, milk fatty acids increased, and milk fat, protein, casein contents, and casein index decreased.The study (16) included examining the early lactation milk metabolic histories of dairy cows and developing models to calculate energy balance based on milk metabolomics information and milk production characteristics. Thirty-one dairy cows were calved, and milk samples were taken at weeks two and seven.The study (17)evaluated the impact of a blend of aromatic compounds on milk output and feed efficiency. Each cow's daily feed intake, milk output, and milk composition were noted, and feed efficiency was computed.The study (18) focused on looking at the manner in which transport stress affected the hematological and physiological reactions as well as the milk production of nursing dairy cows. Transport stress raised cortisol levels, which in turn

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increased leucocyte, neutrophil, and monocyte counts in the blood. However, it did not affect erythrocytes, hemoglobin, or hematocrit levels. Because of the rise in milk somatic cell count, transport also led to a drop in milk supply and a reduction in milk quality.The study (19) compared the feed consumption, production of milk, lactate composition, and organic matter (OM) digestibility in dairy cows fed different types of legumes and grassland.

The rest of the paper as follows: methodology presents part 2, result and discussion describes part 3, and part 4 explains the conclusion of the paper.

METHODOLOGY

Small-scale dairy cow farmers (SDCFs) are becoming more interested in finding solutions to the problem of raising MYs, reflected by the increasing number of DMSs. These approaches aim to provide customized to improve dairy farming methods in all areas, including breeding, nutrition, health care, and overall farm productivity.

Dataset

The data analyzed are from Bharatiya Agro Industries Foundation's (BAIF's) EGP initiative (20). From February 2016 to May 2019, in Jharkhand, Bihar, Maharashtra, Odisha, Punjab, and Uttar Pradesh, cows in small herds with sizes ranging from one to forty-three were employed to collect the phenotypic and associated data.All of the cows were hybrids, with breed compositions unknown, between native Bos indicus cattle from the area and exotic dairy breeds of Bos taurus. The sole imported varieties of dairy cows that have been utilized throughout the previous fifty years of interbreeding in the locations that were examined are Jersey (JR) and Holstein/Friesian (HF). Data that was available included test-day (TD) MY, birth date, parity, birthday, years of age, herd, village, district, state, and Cattle Development capacity (CDC), a local dairy service facility that covers eight to ten regions, where AI distribution and documentation are coordinated. Table (1) and Figure (1) indicates between 1 and 43 cows in each herd, with the majority of the cows (73%) located in herds of three or fewer. CDCs had ranged from 10 to 349 cows each.

Table (1). The quantity of crossbred cows and herd sizes

(Source: https://gsejournal.biomedcentral.com/articles/10.1186/s12711-021-00667-6/tables/1)

Herd size	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12-43**
Cows	2005	2588	1641	956	390	258	119	104	99	90	55	258
Herds	2005	1294	547	239	78	43	17	13	11	9	5	16

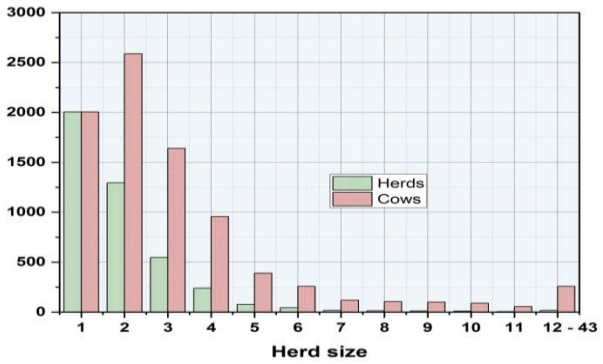

Figure (1). Herd size of cow and herds (Source: Author)

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The number of animals in each herd is indicated in this column. It starts at one and rises to a range of 12–43, where it appears to categorize herd numbers ranging from 12 to 43 into a single category.This table lists the number of herds for each corresponding herd size. A herd of size one could have existed in 2005, a herd of size two in 1294, and so on.The total number of cows in each size herd appears in this column. In 2005 there were 2588 cows in all the size one herds, 1641 cows in all the size two herds, and so on.It appears that herds sized between 12 and 43 are combined into the final group (12–43), which had 16 herds totaling 258 cows.

Analysis of the impacts of farming dairy cow milk in tiny-scale farms

In small-scale farms, a number of factors can affect the farming methods and impact the amount of milk produced by dairy cows. An outline of the ways that various farming techniques could affect milk production in small-scale environments is provided below.

Feeding Practices

Feeding procedures are essential to dairy cow production and well-being. To provide the most effective potential nutrition, these methods combine natural forage with additional feeds and careful management. Only by using grazing practices like rotational and free-range grazing can cows have access to nutrient-rich grass and a balanced diet. For the purpose of meeting nutritional needs, increasing milk production, and improving general health, feeds rich in minerals and vitamins can be supplemented.

Breeding and Genetics

It is essential to select dairy breeds that are suitable for the farm's goals and the surrounding environment. Species that are well-known for their adaptability, sickness resistance, and effectiveness in producing milk are sought by small-scale farmers. These breeds' genetic composition has been investigated in an effort to improve desired characteristics, including high milk production and reproductive efficiency. Farmers who optimize their herd's genetic variety by using exact breeding techniques and carefully choosing the correct breeds can help make SDCF viable and successful.

Climate consideration

The comfort and health of cows are strongly impacted by the local climate, which in turn affects milk output. Farmers have to adapt their methods to take into consideration variables like humidity, temperature extremes, and seasonal changes. By implementing tactics like shade during the warmer months, making sure housing has enough air, and providing extra nourishment during bad weather into practice, it is possible to decrease stress on the cows and keep MY at its peak.

Statistical analysis

As a result of a small number of farms, Chi-square analysis is a suitable statistical tool for assessing hypotheses in dairy cow milk. In contrast to other statistics, the Chi-square statistic can provide specific details not only the magnitude of any significant variability but also the groups that are instigating those variances.Row and column marginal for each cell are used to divide the sample size.Statistics experts employ correlation measures to gauge the importance of a relationship. Cramer's V is the most used Chi-square power test.The Chi-square is an effective tool for data analysis and for determining the type of information being analyzed.

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RESULT AND ANALYSIS

A key component of comprehending the environment of tiny dairy production is the geographical distribution of herd numbers over particular locations. This measure sheds illumination on the variety of enterprises and regionally specific difficulties encountered by small-scale farmers. A comprehensive understanding of the regional information, resource availability, and financial limitations can be obtained by investigating the distribution of herd sizes. Table (2) illustrates the range of herd sizes in the study population and demonstrates the prevalence of small herds in the locations that were chosen.

Table (2). Herd Size Distribution

(Source: Author)

Region	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12-43**
Bihar	2005	1294	547	239	78	43	17	13	11	9	5	16
Jharkhand	1000	800	400	200	100	50	30	25	20	15	10	5
Maharashtra	1200	900	500	300	150	80	40	35	30	25	15	10
Odisha	800	600	300	150	70	40	20	18	15	12	8	5
Punjab	500	400	200	100	50	25	15	12	10	8	5	3
Uttar Pradesh	500	1200	600	300	200	100	50	45	40	30	20	15
Total herds	7005	4994	2547	1392	648	338	172	153	126	99	63	54

A significant indicator for evaluating and contrasting the difficulties experienced by large and small dairy farms is the average ranking score for the causes of milk deterioration throughout the milking process. This score gives a quantitative indication of the perceived influence of each component by ranking several aspects that affect milk quality, such as cleanliness standards, equipment effectiveness, and milking techniques. Small and large dairy farms can be compared to get important insights into potential differences and to make focused changes to the milking process. Figure (2) depicts the milk degradation during milking.

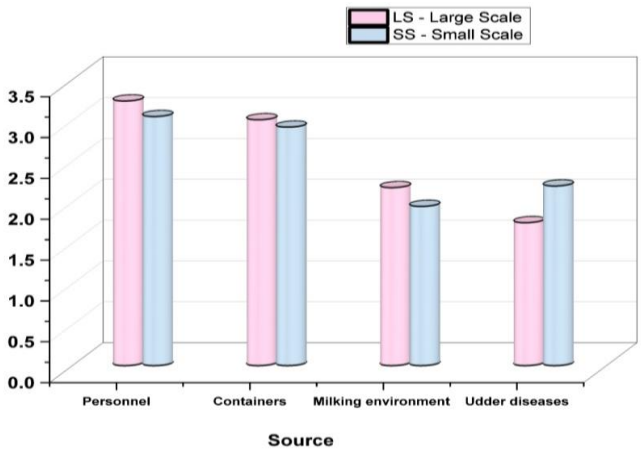

Figure (2). Spoiling of milk during milking

(Source: Author)

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The impact of different seasons on many experimental parameters, such as milk output, constitutes an essential aspect of research on dairy farming. Variations in the seasons can have a substantial effect on environmental conditions, cow nutrition, and the general health of the herd, which can influence MY output. Farmers and academics could acquire important insights from knowing that these factors change with the seasons. For example, variations in cow metabolism and feed availability during cooler seasons may have an impact on milk supply. Figure (3) depicts the variation of seasons in milk output.

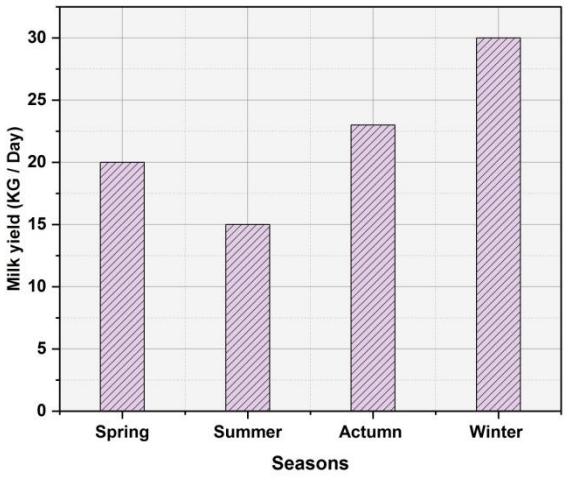

Figure (3). Variation of seasons in milk output

(Source: Author)

A comprehensive understanding of the influence of herd size on milk production throughout various seasons can be obtained by analyzing the variation of seasonality ratios of milk output each cow each day by herd size on small-scale farms. The seasonality ratios of MY in small-scale farms are shown in Figure (4).

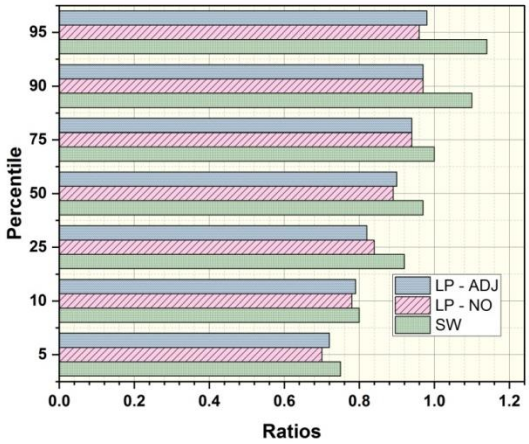

Figure (4). Seasonality of MY in tiny-scale faming

(Source: Author)

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This metric evaluates the amount of milk produced per cow per day changes with the herd size, providing information about the productivity and efficiency of small-scale dairy farms. Seasonality ratios account for variations in the weather throughout year, pasture availability and other environmental factors.

CONCLUSION

The term dairy cow milk yield refers to the amount of milk produced by cows on smaller farms, owned by families. Smaller farms have fewer cows than larger ones, and the milk produced by each cow depends on a variety of factors, including feeding schedules, herd management techniques, and the surrounding environment. The study on the production of milk from dairy cows on small-scale farms demonstrates notable regional differences. It emphasizes the impact of factors such as herd size, seasonal dynamics, milk spoilage during the milking process, and seasonality ratios on the overall efficiency and the potential of output. These complex elements offer valuable information for improving dairy farming methods on a variety of small farms. Using precision farming technologies to enhance feeding procedures, increase overall production efficiency, and monitor and manage individual cows.

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