




## Research Article

## A Comparative Study on the Feeding Practices and Performance of Crossbred and Local Dairy Cattle in Mymensingh Sadar, Bangladesh

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ARTICLE INFO	ABSTRACT
<p><b>Article history</b> Received: 29 December 2026 Accepted: 25 June 2026 Published: 30 June 2026</p> <p><b>Keywords</b> Dairy Cattle, Feeding systems, Milk composition,</p> <p><b>Correspondence</b> Khan Md. Shaiful Islam ✉: <a href="mailto:kmsislam@bau.edu.bd">kmsislam@bau.edu.bd</a></p> <p> OPEN ACCESS</p>	<p>This study explored the impact of different feeding systems on dairy cattle performance in Mymensingh Sadar Upazila, Bangladesh, focusing on milk production, reproduction, and overall output. Three groups were examined: Intensive Holstein Friesian (HF) crossbreds, Semi-intensive HF crossbreds, and Semi-intensive Local cattle. The study found significant differences in feeding methods across the groups. Intensive HF crossbreds were stall-fed with German grass and concentrates, while Semi-intensive HF and Local cattle had access to both stall food and grass. Local cows primarily relied on rice straw. On average, each animal consumed 25.96 kg of feed daily, with Intensive HF crossbreds consumed the greatest amount of feed (20.59 kg). Milk production varied significantly, with Intensive HF crossbreds yielding 6.63 L/day, Semi-intensive HF at 3.99 L/day, and Local cattle at 1.98 L/day. Intensive HF cows also had the highest lactation yield of 1655.45 L. Reproductive traits showed that Intensive HF cows matured earlier (15.15 months) and had shorter calving intervals (13.1 months), indicating better performance in well-managed systems. Milk composition analysis revealed that Local cows produced milk with higher fat content, while Intensive HF cows had higher protein and lactose levels, enhancing milk quality. However, Intensive systems require higher inputs in terms of feed, labor, and veterinary care, making them costly. Semi-intensive HF systems offer a more balanced, cost-effective option, while Local cattle are suited for low-input systems with higher milk fat content, valuable in local markets.</p>
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## Introduction

Dairy cattle are essential to Bangladesh's agricultural economy and food security, yet national milk production remains below demand (Huque, 2014; Samad, 2020). The sector is largely based on low-input smallholder mixed crop–livestock systems, constrained by feed shortages and limited support (Khan et al., 2012; Hossain et al., 2017). To address low productivity, crossbreeding indigenous zebu cattle with high-yielding Holstein Friesian has been widely promoted, increasing the proportion of crossbred cows, especially in peri-urban areas (Huque, 2014; Samad, 2020; Tadesse et al., 2002).

Bangladesh faces a critical shortage of quality feed, with diets mainly based on rice straw, grasses, crop residues, and tree leaves, while concentrate use depends on farmers' financial capacity (Bhuyan et al., 2021). As a result, cattle productivity remains below genetic potential. However, Holstein Friesian crossbreds produce higher milk yields and economic returns under

moderate nutrition and management (Huque, 2014). Studies show they can yield 2–6 times more milk than local cows, increasing household income despite higher feed costs (Anik et al., 2023). Higher genetic merit cows (75–87.5%) further improve body weight, milk yield, and profitability when supported by adequate feeding (Mipa et al., 2022; Rahman et al., 2024). In contrast, indigenous cattle, though low-yielding, remain important due to lower input needs, disease tolerance, and suitability for resource-poor farmers (Hossain et al., 2017; Samad, 2020).

Feeding practices strongly influence dairy performance. Most farmers rely on natural fodder and simple concentrate mixtures, with limited professional guidance. Farms providing balanced metabolizable energy and protein achieve better milk yield and profitability (Mipa et al., 2022; Khan et al., 2012). Typically, crossbred cows receive more green fodder and concentrates, while indigenous cows depend more on straw, reflecting perceived breed requirements (Bhuyan et al., 2021). Crossbreds also show longer

## Cite This Article

Islam, K.M.S. 2026. A Comparative Study on the Feeding Practices and Performance of Crossbred and Local Dairy Cattle in Mymensingh Sadar, Bangladesh. *Journal of Bangladesh Agricultural University*, 24(2): 64-72. <https://doi.org/10.3329/jbau.v24i2.91294>

lactation and higher productivity but require greater investment and management (Samad et al., 2020).

Dairy performance is also affected by management factors such as housing, healthcare, and access to veterinary services, with variability in vaccination and supplementation practices (Hamid, 2025). Major constraints include high feed costs, forage scarcity, limited knowledge, reproductive issues, weak markets, and restricted credit access (Uddin et al., 2012; Quddus, 2018). In Mymensingh, farmers often combine crossbred and indigenous cattle to balance productivity and risk (Anik et al., 2023).

Despite extensive research, locality-specific comparisons of crossbred and indigenous cattle under similar conditions remain limited, particularly in Mymensingh Sadar. Most studies focus on single genotypes or regions, with insufficient data on feeding practices and performance differences (Begum et al., 2017; Mipa et al., 2022).

Therefore, this study examined feeding systems for crossbred cattle under intensive and semi-intensive management and for local cattle under semi-intensive systems, and compared their productive and reproductive performance in Mymensingh Sadar Upazila, Bangladesh.

## Materials and Methods

### Study Area and Duration

A field survey was conducted in Mymensingh Sadar Upazila of Mymensingh district to collect recent information on feeding management practices, productive performance, and reproductive performance of dairy cattle. The study focused on semi-intensive local dairy cows, semi-intensive Holstein Friesian crossbred cows, and intensive Holstein Friesian crossbred cows. Data were collected over a period from mid-December 2024 to mid-January 2025.

The study area is characterized by a humid, warm, and equable climate, with relatively stable temperatures and high humidity levels. Annual temperatures range from 12 °C to 33 °C. Relative humidity exceeds 87% during the monsoon period from July to November and remains around 71% during the dry season from December to March. The region experiences frequent rainfall from May to October.

### Selection of Experimental Animals

Three categories of dairy cattle were included in this study: semi-intensive local dairy cows, semi-intensive Holstein Friesian crossbred cows, and intensive Holstein Friesian crossbred cows. Although several exotic

crossbred cattle types are reared in Bangladesh, Holstein Friesian crossbreds were selected due to their widespread distribution and economic importance. Local dairy cattle in Bangladesh are typically non-descriptive indigenous breeds that are not formally classified based on standardized physical characteristics. These animals exhibit considerable phenotypic variation as a result of diverse genetic backgrounds and adaptation to local environmental conditions. Generally, they are brown, black, or ash in color with a black muzzle.

### Preparation of Questionnaire

A structured questionnaire was carefully developed in alignment with the objectives of the study and with consideration for the livelihood aspects of dairy farmers in Mymensingh Sadar Upazila. The questionnaire included both open-ended and closed-ended questions and was designed to be clear, concise, and easily understandable by respondents. The final version of the questionnaire was reviewed and refined with guidance from the supervisor and co-supervisor.

### Survey Design and Sampling

The survey was conducted using a detailed interview schedule. Ten villages were purposively selected from Mymensingh Sadar Upazila. Dairy farmers owning at least two lactating cows were included in the study, and both small-scale and large-scale dairy farms were represented.

### Interview Schedule

A structured interview schedule was designed to collect relevant and accurate information in accordance with the objectives of the study. Questions were formulated in simple and clear language to ensure ease of understanding by the respondents. The identification and location of dairy farmers were facilitated with the assistance of the Livestock Extension Officer of Mymensingh Sadar Upazila.

### Data Collection Procedure

Data were collected through a door-to-door survey to ensure accuracy and reliability. Information was obtained directly from the heads of farm households through face-to-face interviews. A positive and cooperative relationship was maintained with respondents throughout the survey period. Any unclear questions were carefully explained to respondents to avoid misunderstanding. Farmers were assured that the study was conducted solely for academic purposes and would not have any negative implications for them. Relevant on-farm measurements were taken and recorded using a standardized cow data sheet. In total, data were collected from approximately 350 dairy cows, including 68 intensive Holstein Friesian crossbred cows,

175 semi-intensive Holstein Friesian crossbred cows, and 107 semi-intensive local dairy cows.

#### **Laboratory Analysis of Milk Samples**

Milk samples were collected randomly from the three experimental groups for laboratory analysis. Five samples were collected from each group and analyzed using a Lactoscan Milk Analyzer to determine milk composition. The results were recorded for subsequent analysis.

#### **Statistical Analysis**

Raw data were initially organized using Microsoft Excel and subsequently analyzed using IBM SPSS software (Version 22.0, IBM Corp., USA). All measured parameters were subjected to one-way analysis of variance (ANOVA). Results were expressed as mean  $\pm$  standard deviation (SD). Duncan's Multiple Range Test (DMRT) was applied to determine significant differences among treatment groups, and differences were considered statistically significant at  $P < 0.05$ .

#### **Results**

##### **Feeding system of Intensive Holstein Friesian crossbreds (HFC), semi-intensive HFC and local dairy cows**

Feeding system differed from the type or breed of dairy cows Mymensingh Sadar Upazila. Large scale farmers tend to rear Intensive HF crossbreds which were fully kept in stall feeding system. Whereas, semi-intensive HF crossbreds and semi-intensive local dairy were kept in both stall and grazing system and cut and carry system (traditional system). In traditional rearing system, rice straw was main roughage being used. Each semi-intensive HF crossbreds and semi-intensive local dairy were fed daily on average 5.6kg and 4kg rice straw, respectively. However, In intensive HF there was no grazing practiced. The cows were full time kept in stalls except times of exercise. In other hand, semi-intensive local dairy cattle were being grazed for 6-8 hours and semi-intensive HF crossbred dairy cattle for 5-6 hours.

Concentrate was supplied in proportion to milk production. On average daily 4.45 kg of mixed high-quality concentrate were fed to high-yielding Intensive HF crossbred cows. Semi-intensive HF crossbreds and semi-intensive local dairy each received 3.40 kg and 1.98 kg of mixed concentrates.

##### **Feed intake of Intensive HFC, semi-intensive HFC and local dairy cows**

The table and figure below display the daily feed for various dairy cow breeds. Dairy cow feed supply varies significantly between breeds ( $P < 0.001$ ). Because of the increased milk output needs, intensive HF crossbreds

consumed roughly 1.5 times more feed than semi-intensive HF Crossbreds and three times as much as semi-intensive local. The overall roughage and concentration intakes of the dairy breeds evaluated vary greatly. Intensive HF crossbred dairy cows consume the most roughage and concentrate, followed by semi-intensive HF crossbred dairy cows. Semi-intensive local dairy Cows consume the least amount.

##### **Production Performance of intensive HFC, Semi-intensive HFC and Local Dairy Cows**

There was a substantial difference in body weight among intensive HF crossbreds, semi-intensive HF crossbreds, and semi-Intensive local dairy cows ( $p < 0.001$ ). Body weights for Intensive crossbred, semi-Intensive HF crossbred, and Semi-Intensive Local were roughly 358.55kg, 324.25kg, and 157.8 kg, respectively. Intensive HF crossbreds (6.63 kg) produced significantly more milk than Semi-Intensive HF Crossbreds (3.99 kg) and Semi-Intensive Local (1.98kg) on a daily basis ( $p < 0.001$ ). Lactation Yield differed considerably ( $p < 0.001$ ) among three types of Dairy Breeds, with Semi-Intensive HF crossbred yielding 4 times and Intensive HF crossbred yielding over 7 times that of Semi-Intensive Local Dairy Breeds. Milk yield per body weight differed significantly ( $P < 0.001$ ) between breeds. Semi-intensive HF crossbreds (1.23kg) and semi-intensive local dairies (1.25kg) produced less milk per body weight than intensive HF crossbreds (1.84kg).

##### **Reproductive Performance of Intensive HFC, Semi-intensive HFC and Local Dairy Cows**

Age at sexual maturity was significantly different among three species of cows ( $P < 0.001$ ). The Semi-Intensive Local took the longest to reach sexual maturity, while the Intensive HF crossbred took the shortest. Age at first service differed considerably between breeds ( $P < 0.001$ ). Days were longer in Semi-Intensive Local compared to Semi-Intensive HF crossbred and Intensive HF crossbred. The age at first calving was highest in the Semi-Intensive Local. Then, in Semi-Intensive HF crossbred and Intensive HF crossbred correspondingly. There was a substantial difference in calves' birth weight between Intensive HF crossbred, Semi-Intensive HF crossbred, and Semi-Intensive Local ( $P < 0.001$ ). In the selected localities, intensive HF crossbreds had a higher birth weight than semi-intensive HF crossbreds and semi-intensive locals. Intensive HF crossbred Dairy cows had the shortest calving interval, while Semi-Intensive Local Dairy cows had the longest ( $P < 0.001$ ). The lactation period differed considerably among all three cow groups ( $P < 0.001$ ). Intensive HF crossbred dairy cows had the most days at milk. Semi-Intensive Local Dairy has the lowest lactation period among these three cow categories.

### **Milk Components of Intensive HFC, semi-intensive HFC and local dairy cows**

Milk Fat contents were significantly different in all three cow groups ( $P < 0.001$ ). Semi-Intensive Local Dairy cows had the highest fat content in milk. Intensive HF crossbred Dairy cows being the lowest in Milk Fat contents among these three cow groups. Dry Matter

(DM) was significantly different among the different breeds ( $P < 0.001$ ). DM was higher in Intensive HF crossbred than Semi-Intensive Local and Semi-Intensive HF crossbred. DM content was highest in Intensive HF crossbred then in Semi-Intensive Local and Semi-Intensive HF crossbred respectively. Protein Content was statistically significant among three types of cows ( $P < 0.039$ ). Protein Content was higher in Intensive HF crossbred than semi-Intensive HF crossbred and Semi-Intensive Local Dairy Cows.

### **Discussion**

#### **Body weight**

In the present study, among all experimental groups, intensively managed Holstein Friesian (HF) crossbred cows exhibited the highest body weight (358.55 kg). Although some studies conducted in Bangladesh and temperate regions have not reported comparable values, a significantly higher body weight of Holstein Friesian cattle compared to other breeds has been consistently documented. Hossain et al. (1982) reported a mean body weight of 323 kg for Holstein Friesian crossbred cows under Bangladeshi conditions, which is lower than the value observed in the current study. Conversely, studies conducted in temperate regions have reported considerably higher body weights. Walsh et al. (2008) stated that Holstein cows with 52% Holstein genetics attained body weights exceeding 603 kg, which contradicts the findings of the present experiment. In contrast, semi-intensively managed local cows exhibited significantly lower body weight compared to HF and HF crossbred cows, which may be attributed to their lower genetic potential and comparatively less intensive management practices.

Specifically, the body weight of semi-intensive local cows was 157.8 kg, markedly lower than that of intensively managed HF and semi-intensive HF crossbred cows.

#### **Daily milk yield**

The daily milk yield observed in this study is consistent with previous research showing that crossbred dairy cattle outperform indigenous cows in milk production. Crossbred animals, particularly those with higher Holstein Friesian inheritance, produced significantly more milk per day than local cattle ( $p < 0.001$ ). Similar results were reported by Mamun et al. (2016), who found that Holstein Friesian crossbred cows yielded  $7.64 \pm 1.74$  L/day, compared with only  $1.75 \pm 0.07$  L/day in indigenous cows under smallholder conditions. Likewise, Saha et al. (2024) reported that Holstein  $\times$  local crossbreds produced 10.89 kg/day, which was 42.4 % higher than local cattle (7.65 kg/day). In a district-level study in Comilla, Uddin et al. (2011) observed significantly higher milk yield in Friesian crossbreds ( $7.36 \pm 0.11$  L/day) than in indigenous cows ( $2.35 \pm 0.04$  L/day). These findings confirm that genotype is a major determinant of milk yield, and the superior performance of crossbreds is largely attributed to heterosis and the additive genetic effects of Holstein Friesian inheritance, which enhance lactation potential.

#### **Lactation yield**

The average lactation yields for different genetic groups are presented in Table 4.3. The results indicate that Intensive Holstein Friesian (HF) crossbreds produced the highest average lactation yield (1,655.45 L per lactation), followed by Semi-Intensive HF crossbreds (992.45 L), and Semi-Intensive Local breeds (392.96 L), which is consistent with the findings of Wahinya (2020). These results confirm that genetic makeup has a significant influence on lactation performance. Intensive HF crossbreds outperform semi-intensive and local breeds, highlighting the combined effects of genetics and management practices on milk production.

**Table 1: Comparison of the feeding system of intensive HFC, semi-intensive HFC and local dairy cows**

Parameters	Intensive HF Crossbred Dairy cows	Semi-Intensive HF Crossbred Dairy Cows	Semi-Intensive Local Dairy Cows
Feeding System	Stall feeding	Stall and Grazing	Stall and Grazing
Roughage type and amount (kg/d/cow)	Rice straw	1.03 $\pm$ 0.28	1.14 $\pm$ .26
	Green grass	Cultivated German grass (20.48 $\pm$ 1.04)	German grass, Roadside grass (18.32 $\pm$ 0.53) and homestead forages
Grazing time	0	5-6 hours	6-8 hours
Concentrate type and amount (Kg/d/cow)	Mixed type (4.45 $\pm$ 0.37)	Mixed type (3.40 $\pm$ .20)	Mixed type (1.98 $\pm$ 0.34)

Data shown in table is mean  $\pm$  SD

**Table 2: Nutritional Comparison of Intensive HFC, semi-intensive HFC and local dairy cows**

Parameters	Intensive HFC	Semi-intensive HFC	Semi-intensive Local	P-value
Total Feed Intake (kg/day)	25.96 <sup>a</sup> ±1.27	20.59 <sup>b</sup> ±0.57	9.59 <sup>c</sup> ±1.06	<0.001
Total Roughage Intake (kg/day)	21.51 <sup>a</sup> ±0.93	19.45 <sup>b</sup> ±0.48	9.46 <sup>c</sup> ±0.78	<0.001
Total Concentrate Intake (kg/day)	4.45 <sup>a</sup> ±0.37	1.13 <sup>c</sup> ±0.25	3.69 <sup>b</sup> ±0.95	<0.001
Total Dry Matter Intake	8.08 <sup>a</sup> ±0.49	6.78 <sup>b</sup> ±0.22	3.58 <sup>c</sup> ±0.42	<0.001
Dry matter per kg Body weight	0.022 <sup>a</sup> ±0.005	0.021 <sup>b</sup> ±0.003	0.022 <sup>a</sup> ±0.001	<0.001
Total Roughage (DM Basis)	4.30 <sup>a</sup> ±0.19	3.89 <sup>b</sup> ±0.09	1.89 <sup>c</sup> ±0.16	<0.001
Total Concentrate (DM Basis)	3.78 <sup>a</sup> ±0.32	2.88 <sup>b</sup> ±0.14	1.68 <sup>c</sup> ±2.9	<0.001

a,b,c values with different superscripts in the same row differ significantly (P<0.05); Data shown in table is mean ± SD

**Table 3: Performance metrics of intensive HFC, semi-intensive HFC and local dairy cows**

Parameters	Intensive HFC	Semi-intensive HFC	Semi-intensive Local	P-value
Body Weight (Kg)	358.55 <sup>c</sup> ±15.5	324.25 <sup>b</sup> ±8.13	157.8 <sup>a</sup> ±13.08	<0.001
Milk Yield (L/day)	6.63 <sup>a</sup> ±0.93	3.99 <sup>b</sup> ±0.41	1.98 <sup>c</sup> ±0.33	<0.001
Lactation Yield (L/L)	1655.45 <sup>a</sup> ±241.76	992.45 <sup>b</sup> ±98.98	392.96 <sup>c</sup> ±71.29	<0.001
Milk Yield per 100 Kg Body Weight (Kg)	1.84 <sup>a</sup> ±0.19	1.23 <sup>b</sup> ± 0.107	1.25 <sup>b</sup> ± 0.17	<0.001

a,b,c values with different superscripts in the same row differ significantly (P<0.05); Data shown in table is mean ± SD

**Age at sexual Maturity**

Average value of different genotypes of age at sexual maturity were 15.15, 17.1 and 24.7 months of Intensive HF crossbred, Semi-Intensive HF crossbred and Semi-Intensive Local respectively (Table 4.4) and Statistical analysis showed that it was significant (P<0.001). The findings of this study showed that the age at sexual maturity of semi-intensive local is closely similar and semi-intensive HF is more or less similar as Miazi *et al.*, (2007). Intensive HF crossbreds maturing earliest, these results show that management system and genotype greatly affect the age of sexual maturity, therefore highlighting the possibility for enhanced reproductive performance through best breeding and management techniques.

**Age at First Calving**

Genotype significantly affected age at first calving (AFC) in this study (p < 0.001). Crossbreds generally calve earlier than indigenous cows, reducing the generation interval. In Bangladesh, indigenous cows calved about four months later than HF crossbreds under smallholder conditions (Mamun *et al.*, 2016). In Shirajgonj, crossbreds averaged 31.2 ± 1.3 months versus 37.6 ± 1.3 months for indigenous cows (Paul *et al.*, 2013). In Kishoreganj, Local × Friesian crossbreds had an AFC of 33.3 months, illustrating variation among crossbreds (Saha *et al.*, 2024). These findings highlight that genetics and management jointly influence reproductive efficiency.

**Table 4: Comparison of the reproductive traits of Intensive HFC, semi-intensive HFC and local dairy cows**

Parameters	Intensive HFC	Semi-intensive HFC	Semi-intensive Local	P-value
Age at sexual maturity (months)	15.15 <sup>c</sup> ± 10.93	17.1 <sup>b</sup> ± 0.91	24.7 <sup>a</sup> ± 1.21	<0.001
Age at first service (months)	17.25 <sup>c</sup> ± 1.06	19.15 <sup>b</sup> ± 0.75	27.15 <sup>a</sup> ± 0.98	<0.001
Age at first calving (months)	26.73 <sup>c</sup> ± 1.19	28.42 <sup>b</sup> ± 0.81	36.71 <sup>a</sup> ± 0.85	<0.001
Calves Body Weight (Kg)	27.25 <sup>a</sup> ± 2.07	24.5 <sup>b</sup> ± 1.43	22.65 <sup>c</sup> ± 1.53	<0.001
Calving Interval (months)	13.10 <sup>c</sup> ± 0.85	14.1 <sup>b</sup> ± 0.79	16.1 <sup>a</sup> ± 0.91	<0.001
Gestation period (days)	279.05 ± 5.70	280.00 ± 5.47	282.00 ± 3.73	0.461
Lactation period (days)	249.75 <sup>a</sup> ± 5.29	248.75 <sup>a</sup> ± 7.03	198.15 <sup>b</sup> ± 10.03	<0.001

a,b,c values with different superscripts in the same row differ significantly (P<0.05); Data shown in table is mean ± SD

**Table 5: Comparison of the Milk Components of Intensive HFC, semi-intensive HFC and local dairy cows**

Parameters	Intensive HFC	Semi-intensive HFC	Semi-intensive Local	P-value
Fat (%)	2.87 <sup>a</sup> ± 0.10	3.42 <sup>b</sup> ± 0.06	3.93 <sup>a</sup> ± 0.28	<0.001
Lactose (%)	4.98 <sup>a</sup> ± 0.22	4.53 <sup>b</sup> ± 0.24	4.60 <sup>b</sup> ± 0.31	0.039
Protein (%)	3.30 <sup>a</sup> ± 0.16	3.00 <sup>b</sup> ± 0.16	3.05 <sup>b</sup> ± 0.21	0.045
Minerals (%)	0.60 <sup>b</sup> ± 0.00	0.70 <sup>a</sup> ± 0.00	0.70 <sup>a</sup> ± 0.00	<0.001
Solids-not-fat (%)	9.65 <sup>a</sup> ± 0.39	8.94 <sup>b</sup> ± 0.43	9.07 <sup>ab</sup> ± 0.57	0.075
Total Solids (%)	12.52 ± 0.37	12.35 ± 0.47	13.00 ± 0.68	0.170
Fat (g/day)	0.20 <sup>a</sup> ± 0.02	0.20 <sup>b</sup> ± 0.02	0.08 <sup>c</sup> ± 0.008	<0.001
Lactose (g/day)	0.36 <sup>a</sup> ± 0.04	0.18 <sup>b</sup> ± 0.01	0.27 <sup>c</sup> ± 0.03	<0.001
Protein (g/day)	0.24 <sup>a</sup> ± 0.02	0.12 <sup>b</sup> ± 0.01	0.06 <sup>c</sup> ± 0.01	<0.001
Minerals (g/day)	0.04 <sup>a</sup> ± 0.01	0.02 <sup>b</sup> ± 0.01	0.01 <sup>c</sup> ± 0.01	<0.001
Solids-not-fat (g/day)	0.70 <sup>a</sup> ± 0.08	0.36 <sup>b</sup> ± 0.02	0.19 <sup>c</sup> ± 0.02	<0.001
Total Solids (g/day)	0.91 <sup>a</sup> ± 0.10	0.50 <sup>b</sup> ± 0.04	0.27 <sup>c</sup> ± 0.03	<0.001

a,b,c values with different superscripts in the same row differ significantly (P<0.05); Data shown in table is mean ± SD

### Calving interval

Average value of different genotypes of calving interval are showed at table 4.4. The calving interval of Intensive HF, semi-intensive HF crossbred and semi-intensive Local were on an average 13.1, 14.1 and 16.1 months respectively. The result was more or less similar as Miaz *et al.*, (2007) who was found calving interval of

semi-intensive HF crossbred and semi-intensive Local 14.2 and 15.40 months respectively. The results imply that, especially in HF crossbreds, intensive and semi-intensive management systems have a major impact on lowering calving intervals, therefore supporting the possibility for enhanced reproductive performance under better management.

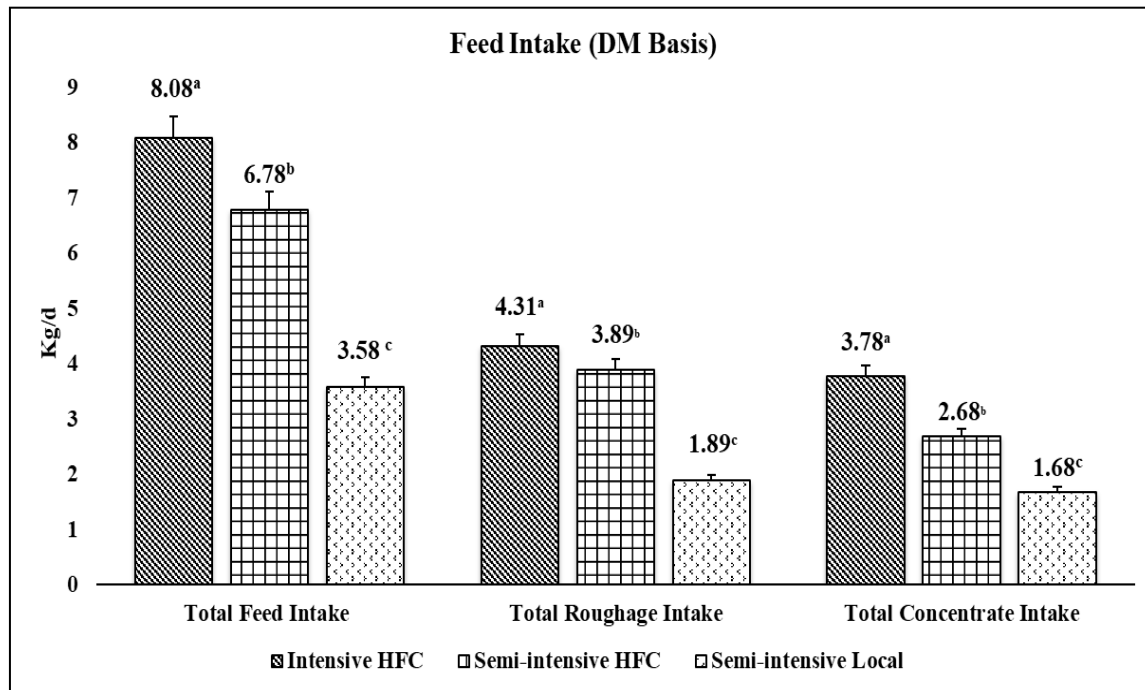


Figure 1: Overview of feed intake in experimental cattle

### Gestation Length

Average value of different genotypes of gestation length are showed at table 4.4. The gestation length of Intensive HF, semi-intensive HF crossbred and semi-intensive Local were on an average 279.05, 280 and 282

days respectively which were similar with Uddin *et al.*, (2008). The similarities in gestation time among all genotypes suggests that, independent of genotype or management strategy, gestation period stays rather constant.

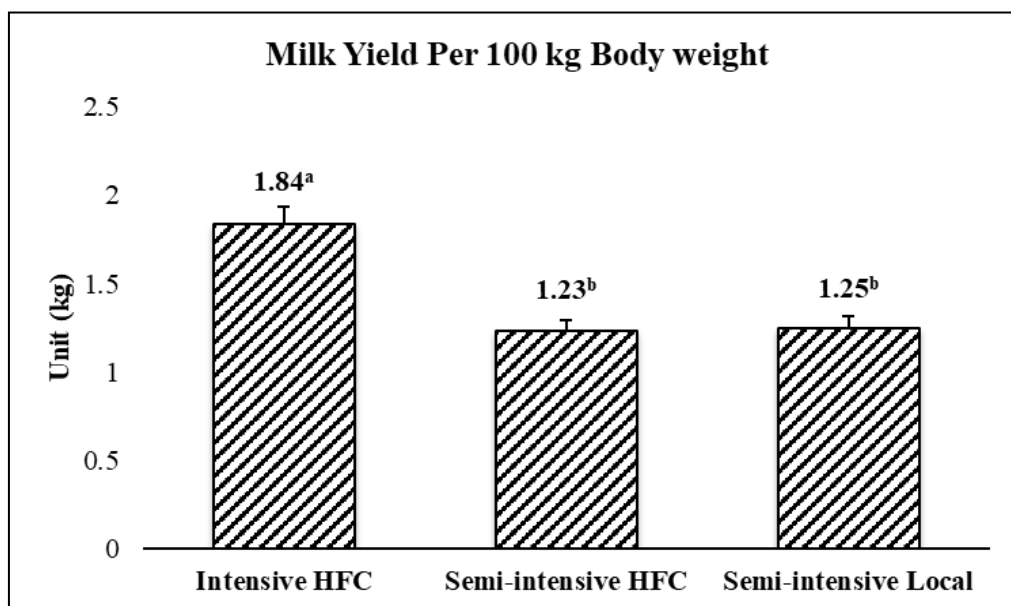


Figure 2: Overview of milk yield in experimental cattle

**Lactation length**

The average lactation length for different genetic are presented in Table 4.4. It was found that the average lactation length for Intensive HF crossbred was 249.75 days/Lactation which is contradict with Haque et al (2013), Semi-Intensive HF crossbred was 248.75 days which is as similar as Miazi et al (2007) and Semi-Intensive Local dairy was 198.15 days which is less similar with Mwacharo and Rege (2002). HF crossbreds exhibit superior performance under both systems, as evidenced by the variation in lactation duration among various genotypes and management systems. This demonstrates the influence of genetic and environmental factors on milk production potential.

**Fat content of milk**

Milk fat differed significantly among genotypes and management systems ( $p < 0.001$ ), highest in semi-intensive local cows, followed by semi-intensive HF crossbreds, and lowest in intensive HF crossbreds. This reflects the common trend that local cows produce higher-fat milk despite lower yield, while high-yielding HF crossbreds have diluted solids (Sanjayaranj et al., 2022, 2023). Crossbreeding with Jersey genetics can enhance fat content, and feeding practices also influence milk fat. Intensive feeding alone did not compensate for HF crossbreds’ lower fat potential, whereas semi-intensive systems with grazing and

natural forage improved fat levels, particularly in local cows. These results highlight that breed, management, and diet together determine milk fat composition.

**Lactose content of milk**

There was a significant difference ( $p=0.039$ ) in the lactose percentage between the cow groups in this study. The highest lactose amounts were found in intensive Holstein Friesian (HF) crossbreds, followed by semi-intensive local and semi-intensive HF crossbreds. Even though the difference was pretty small, it shows that breed and management methods can still change this milk component, even though it is usually stable. According to Priyashantha (2021), lactose level is one of the most stable parts of milk, with only small changes seen between breeds and systems. The higher lactose percentage seen in intensive HF crossbreds may be because they are fed the same way every day and their surroundings are controlled, which lowers physiological stress and supports stable mammary gland metabolism. On the other hand, semi-intensive systems—especially those with local cows—might bring more variation because the quality of the grazing might change, which could result in slightly lower lactose levels. Lactose synthesis can also be affected by things like somatic cell count (SCC), farm cleaning, and the health of the cows in general.

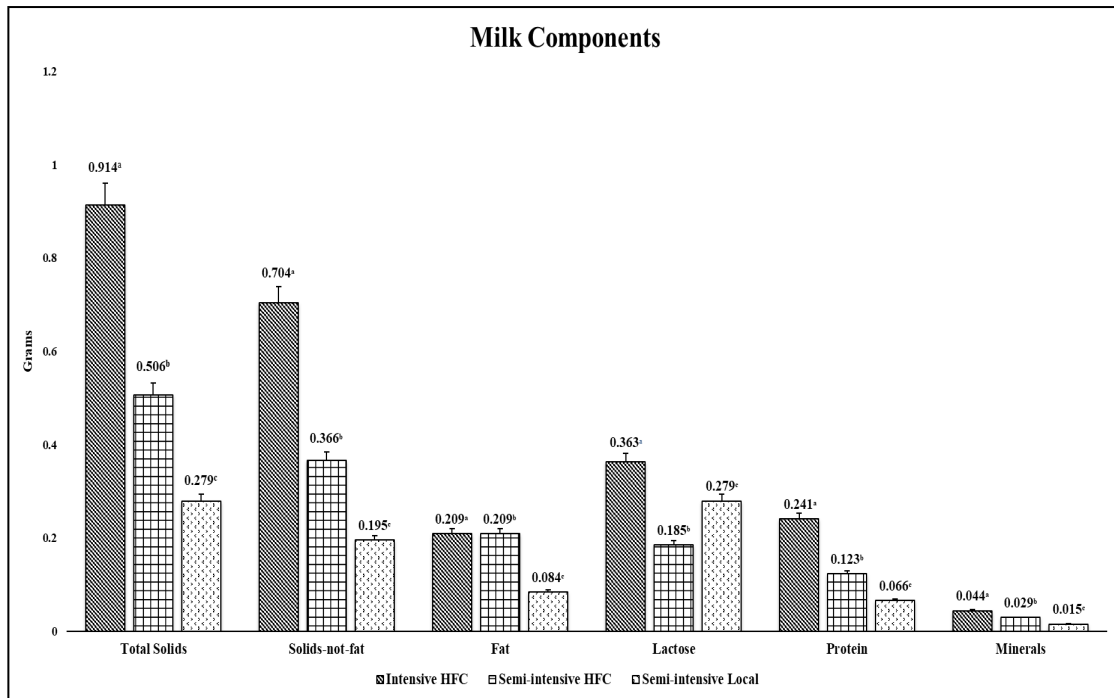


Figure 3: Overview of milk components in experimental cattle

**Protein content of milk**

Milk protein differed significantly among genotypes ( $p = 0.045$ ), highest in intensively-managed Holstein Friesian (HF) crossbreds, followed by semi-intensive crossbreds,

and lowest in local cows. This reflects the combined effects of genetics and feeding management. Higher protein in crossbreds is linked to better nutrition and rumen microbial protein synthesis, while lower protein

in local cows may result from lower genetic potential and less nutrient-rich diets. Crossbreeding can enhance milk protein, though trade-offs in fat and vitamins exist (Solarczyk et al., 2024). Overall, milk protein is strongly influenced by breed and management, favoring intensively-fed crossbreds.

## Conclusion

This study demonstrates that intensive management of Holstein Friesian crossbreds (HFC) yields superior milk production and reproductive performance, while semi-intensive (HFC) systems provide a more cost-effective and practical option under typical farming conditions. Indigenous cattle, despite lower productivity, remain important for their adaptability and higher milk fat content in low-input systems. Overall, improving feeding strategies and promoting appropriate breed–management combinations are essential to enhance dairy productivity and sustainability in Bangladesh.

## Data availability Statement

The authors confirm that all data supporting the findings of this study are fully available without restriction. All relevant data are included within the paper, and the raw datasets can be obtained from the corresponding author upon reasonable request and with permission from the Animal Nutrition Laboratory, Bangladesh Agricultural University, Bangladesh.

## Acknowledgements

The authors wish to express their sincere gratitude to BAURES (project number-2024/81/BAU) and the Department of Animal Nutrition for financial support, facilities, and continuous guidance that made this research possible.

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