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Production performance, breeding practices and challenges of Holstein-Local crossbred cattle in some selected areas of Bangladesh

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ABSTRACT

The aim of this study was to investigate productive and reproductive performances, current cattle breeding practices and its associated problems in different Holstein-Local (HF×L) crossbred genotypes under existing management condition of Bangladesh. Data on HF×L crossbred dairy cows were collected from the selected farmers of Natore, Sirajganj, Kishoreganj, Tangail and Gazipur districts while breeding bulls' information were collected from different cattle breeding service providers. Genotype had significant effects on weight at first heat (WFH), mature body weight (MBW), age at first heat (AFH), age at first calving (AFC), post-partum heat period (PPHP), daily milk yield (DMY) and peak milk yield (PMY) ($P<0.05$) except the traits birth weight (BW) and service per conception (SPC). The HF75%×L25% crossbreds had significantly better AFH and AFC ($P<0.001$) than the three genetic groups having 50%, 62.5% and >75% HF inheritance. The highest DMY was found in >HF75%×L<25% (12.80±0.72 liters) and was lowest in HF50%×L50% (5.34±0.65 liters) crossbreds. At present 11 different graded breeding bulls have been used in artificial insemination (AI) program of Bangladesh. Use of heterogeneous breeding bulls (72.9%), AI technicians depended bull's genotype selection (63%), absence of breeding data recording (89%) system and local market-based cow purchasing (83%) with unknown pedigree information were the major challenges identified for crossbred cattle development. Among the investigated samples, 27% cows suffered from various reproductive disorders like dystocia, low conception rate, abortion and retention of placenta. In conclusion, this study provides baseline information on actual production and reproduction potentials of different graded HF×L cows at farmers' level and the associated limiting factors for crossbred cattle development in Bangladesh.

Introduction

The smallholder dairy farming under subsistence production system is the backbone of dairy cattle industry in Bangladesh. Nearly 24.86 million heads of cattle are distributed throughout the country (DLS, 2022). The cattle population of Bangladesh consisted of various Local (L) varieties along with exotic pure breeds like Holstein-Friesian (HF), Sahiwal (SL) and their resultant crossbreds at different levels of genetic combinations (Bhuiyan et al., 2021). More than 70% of the dairy farmers are belong to smallholders where they produce about 70-80% of the country's total milk (Uddin et al., 2012). Although, the livestock concentration per unit land is higher compared to other developed countries, their productivity is relatively low due to poor genetic make-up, unplanned breeding, inadequate feed supply and lack of improved systematic management (Bhuiyan et al.,

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2017). Dairy sector is undergoing a rapid transformation in Bangladesh due to country's growing demand for milk and meat. The total production of milk and meat in FY 2022-23 were 15.85 and 7.61 million metric tons, respectively, which make available of milk at 221.89 ml/day/head against the requirement of 250 ml/day/head (BBS, 2022). However, meat production is self-sufficient in Bangladesh on the basis of per capita consumption at 120 g/day/head. Intensive production system has been expanded by preferring improved and better performing dairy breeds and crossbreds. The first National Livestock Breeding Policy was adopted in 1982 and later on, it was revised in 2007 with clear animal breeding guidelines and directions (NLDP, 2007) that emphasizes on both selective and crossbreeding or up-grading program particularly in cattle. Accordingly, up-gradation of indigenous cattle verities has been operated for the last few decades in order to rapid increment of milk production potentials through introduction of high yielding temperate and tropical dairy breeds.

The milk production performance of the most dominant and preferred HF×L crossbred cows has improved substantially from 5 to 12 liters/day under Bangladesh condition (Siddiquee et al., 2013). Previous studies reported significant differences ($P<0.05$) in daily milk yield, peak daily milk yield, lactation length, dry period, age at first heat, age at first service, age at first calving, calving interval, post-partum heat period and services per conception among the available crossbred genotypes of Bangladesh (Siddiquee et al., 2013 and 2014; Khoda et al., 2015). However, the performances of the crossbred dairy animals of Bangladesh are heterogeneous and sometimes unexpectedly poor. In reality, the indiscriminate upgrading and crossbreeding programs has produced a large number animals with unknown breed composition and pedigree. On the other hand, farmers always give emphasis only on more milk production ignoring adaptability and stress tolerance capability of the crossbreds. Earlier studies showed that the increasing proportion of exotic inheritance may increase milk and meat production exponentially at the expense of reproduction and fitness traits in HF×L upgraded cattle of Bangladesh (Bhuiyan et al., 2015).

The major limitations in existing cattle breeding practices are due to lack of knowledge about breed, breeding policy and scientific animal breeding. Ojango et al. (2017) and Kebede et al. (2018) identified several challenges in smallholder dairy cattle crossbreeding in the tropical countries like absence of good infrastructure, poor recording and monitoring systems, insufficient trained manpower and limited involvement of farmers when designing crossbreeding programs. Quddus (2013) identified several limiting factors in the dairy farms of Bangladesh like poor adoption of vaccination, artificial insemination, deworming along with traditional feeding and farm management practices. Notably, only phenotypic selection of bulls is also major hindrance for development of better productivity crossbred animals (Bhuiyan et al., 2017). Although the farmers are highly interested about crossbred cows but for various limitations, they have been deprived of to achieve the target. Therefore, it is essential to identify the associate problems related to cattle breeding practices in order to overcome the existing limitations and to design a well-planned breeding program for sustainable development of crossbred or upgraded cattle with desired production. Therefore, this study aimed to quantify productive and reproductive performances of HF×L crossbred cattle with different genetic proportions and their existing breeding practices and challenges in some selected regions of Bangladesh.

Materials and Methods

Study areas and farmers

This study was conducted in different villages of 5 districts of Bangladesh namely Natore, Tangail, Kishoreganj, Gazipur and Sirajganj. Farmers were selected randomly from the villages those who had at least 2-3 crossbred cows and were being maintained under semi-intensive or intensive management condition. A total of 35 farmers' herds were included in this study and in total, performance records were collected from 86 crossbred cows. In most cases, preferences were given to select educated farmers for ensuring the collection of relevant and authentic information. Data were collected from the selected herds during July 2022 to November 2022.

Preparation of questionnaire and data collection

A three pages structured questionnaire was designed and pre-tested in order to collect all sorts of objective data on production,

reproduction, reproductive disorders, current cattle breeding scenarios and associated problems for crossbred cattle in the studied areas. Data were collected through visual observation, interaction with farmers and on-spot measurement of different traits at farmers' premises. Digital weighing balance and measuring tape was used to quantify productive and morphometric traits. Genotype of the animals was ascertained through discussion with farmers as well as tracing the available pedigree. During data collection, all possible efforts were made to collect reasonably accurate and reliable information from their herds. The investigated traits were genotype of the cow, breeding service providers, common reproductive problems, birth weight (BWT) of calf, mature body weight (MBW), weight at first heat (WFH), age at first calving (AFC), post-partum heat period (PPHP), service per conception (SPC), average daily milk yield (DMY), peak milk yield (PMY) and lactation length (LL).

Collection of breeding bull information

Information on National Technical Regulatory Committee (NTRC) certified 553 breeding bulls were collected from the respective breeding service providers as well as from the DLS website (NTRC, 2022). These bulls have been used in artificial insemination program of Bangladesh by public and private breeding service providers.

Statistical analysis

The collected data were coded, compiled and tabulated in the Microsoft Excel sheet and extreme values were excluded from the data sheets. Descriptive statistics such as number, frequency and percentage distribution were used in describing the variables. ANOVA was performed using completely randomized design model that implemented by Agricolae package in R (Mendiburu and Yaseen M, 2021). Pastecs package implemented by R was utilized (Grosjean et al., 2018) to establish significant differences between means.

The genotype, location and parity of the cow were considered as fixed effect on considered traits where the effects were calculated according to the following model;

$$Y_{ijklm}=\mu+G_{(i)}+L_{(j)}+P_{(k)}+(GL)_l+(GP)_m+ e_{ijklm}$$

Where, Y_{ijklm} = the dependent variable (traits); μ = the overall mean; G_i = the fixed effect of ith genotype (50%, 62.5%, 75% and >75% HF inheritance); L_j= the fixed effect of jth location (1, 2, 3, 4 and 5); P_k = the effect of kth parity (1, 2, 3, 4, 5, 6, 7 and 8);$(GL)_l$ = The interaction effects between genotype and location; $(GP)_m$ = The interaction effects between genotype and parity and e_{ijk}= the random residual error.

Results

Productive and reproductive performances of crossbred cattle

The investigated crossbred cattle population was categorized into four different groups based on their genetic proportions (50%, 62.5%, 75% and >75% HF inheritance). Most of the studied traits viz. WFH, MBW, AFH, AFC, PPHP, DMY, PMY and LL differed significantly (P<0.05) among the four genetic groups except the traits BW and SPC which varied insignificantly (P>0.05) (Table 1).

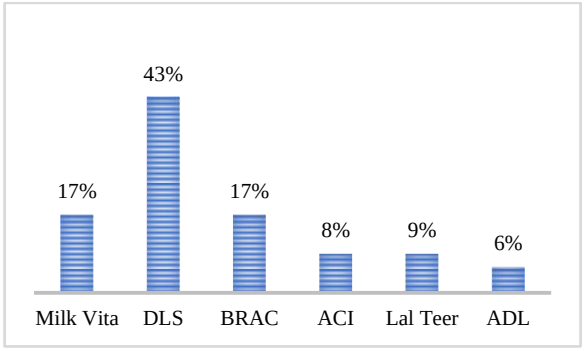

Figure 1: Major breeding service providers and their shares in the surveyed areas of Bangladesh.

As expected, growth performances increased proportionately with the progression of HF inheritance. The highest WFH (223.00±6.08) and MBW (451.47±18.09) was found in >HF75%×L<25% crossbred cows where the lowest values were observed in HF50%×L50% crossbred cattle (175.27±8.15 and 351.56±15.25, respectively). The WFH of the crossbred genotypes varied from 175.27±8.15 to 223.00±6.08 kg and was found statistically significant (P<0.001) among the HF crossbred genotypes. The HF75%×L25% crossbreds had significantly better AFH and AFC than the three other genetic groups (P<0.001). The PPHP was also found better in HF75%×L25% crossbred cows. The HF62.5%×L37.5% crossbreds required

longest periods to attain puberty (23.27±1.50 months) while the lowest duration was observed in HF75%×L25% crossbred cattle (17.03±0.31 months). HF50%×L50% crossbreds had significantly lowest DMY and PMY than three other crossbreds. Notably, the >HF75%×L<25% crossbred genotypes produced highest milk (12.80±.72 liters) having insignificant difference with HF75%×L25% (11.76±0.80) and HF62.5%×L37.5% (11.27±0.71) crossbred cattle. Similar trends also observed among the above three crossbred genotypes for PMY and LL traits.

Table 1: Least-squares means with standard errors of productive and reproductive traits in HF×L crossbred cattle of Bangladesh

Trait	Genotype (Mean ± SE)				LS
	HF50%×L50% (22)[1]	HF62.5%×L37.5 % (11)	HF75%×L25% (32)	>HF75%×L<25 % (21)	
BW (kg)	29.77±1.03	29.09±1.38	28.53±0.99	29.47±1.31	NS
WFH (kg)	175.27^{c}±8.15	207.09^{ab}±4.97	199.25^{b}±9.32	223.00^{a}±6.08	***
MBW (kg)	351.56^{c}±15.25	352.72^{bc}±16.68	424.52^{ab}±20.29	451.47^{a}±18.09	**
AFH (month)	22.90^{a}±0.81	23.27^{a}±1.50	17.03^{b}±0.31	20.38^{a}±1.35	***
AFC (month)	34.04^{a}±0.95	34.63^{a}±1.81	28.26^{b}±0.22	31.33^{ab}±1.37	***
PPHP (day)	72.50^{b}±3.29	68.81^{b}±2.36	66.47^{b}±1.10	88.80^{a}±5.62	***
SPC (no.)	1.31±0.15	1.27±0.14	1.40±0.10	1.42±0.16	NS
DMY (liter)	5.34^{b}±0.65	11.27^{a}±0.71	11.76^{a}±0.80	12.80^{a}±0.72	***
PMY (liter)	8.02^{b}±0.93	13.36^{ab}±0.75	16.28^{a}±1.21	18.11^{a}±1.15	***
LL (month)	8.54^{b}± 0.33	9.40^{ab}±0.37	9.08^{ab}±0.24	9.67^{a}±0.39	*

*NS , P>0.05; * , P<0.05; ** ,P<0.01; *** , P<0.001. [1]Values in the parentheses represent the number of samples under respective genotype. BW , birth weight; WFH , weight at first heat; MBW , mature body weight; AFH , age at first heat; AFC , age at first calving; PPHP , post-partum heat period; SPC , service per conception; DMY , daily milk yield; LS, Level of Significance; PMY , peak milk yield and LL , lactation length.*

Cattle breeding practices in the studied areas

The NTRC certified 553 breeding bulls were maintained by six breeding service providers where 11 different crossbred or upgraded genotypes of HF, L and SL cattle were found (Table 2).

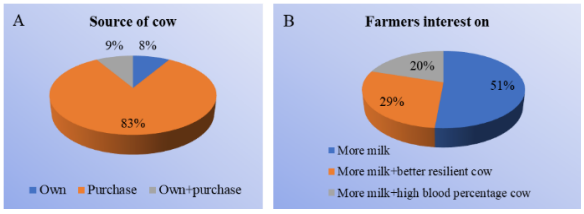

Figure 2: Information on source of cows (A) and dairy farmers interest (B) in the surveyed areas.

Among them, 75%HF×25%L bulls were predominant to the breeding service providers (25.67%). The proportions of 50%HF×50%L, 62.5%HF×37.5%L and 87.5%HF×12.5%L breeding bulls were 13.01, 4.52 and 9.58%, respectively. On the other hand, pure HF (100%) has been maintained by mostly non-govt. and private breeding service providers (BRAC, ACI, ADL and Ejab).

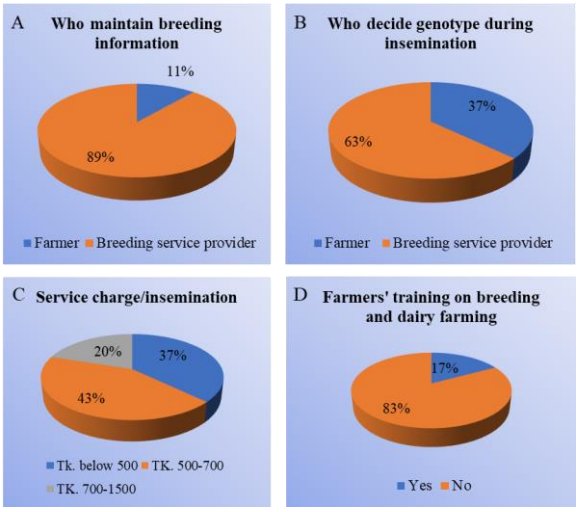

Figure 3: Information on record keeping (A), artificial insemination (B and C) and farmers training (D) in the surveyed areas of this study.

The NTRC certified Sahiwal cattle genotypes were 100%SL, 87.5%SL×12.5%L and 75%SL×25%L accounting 13.01, 10.30 and 5.24% respectively of the total breeding bulls those were managed by the aforementioned organizations.

Table 2: NTRC certified available breeding bulls at the possession of different breeding service providers of Bangladesh[1]

Breed/Genotype	Breeding Service Providers							Total
	DLS	BRAC	ADL	ACI	Lal Teer	Ejab	SOJAG	
50%HF-50%L	52 (25.74%)	1 (0.65%)	11 (19.64%)	-	-	8 (20.51%)	-	72 (13.01%)
62.5%HF-37.5%L	25 (12.37%)	-	-	-	-	-	-	25 (4.52%)
75%HF-25%L	83 (41.08%)	17 (11.18%)	1 (1.78%)	14 (16.67%)	6 (35.29%)	15 (38.46%)	6 (75%)	142 (25.67%)
87.5%HF-12.5%L	2 (0.99%)	40 (26.31%)	-	10 (11.90%)	-	-	1 (12.5%)	53 (9.58%)
93.75%HF-6.25%L	-	-	-	8 (9.52%)	-	-	-	8 (1.44%)
100% HF	2 (0.99%)	11 (7.23%)	3 (5.35%)	11 (13.09%)	-	5 (12.82%)	-	32 (5.78%)
50%HF-50%SL	6 (2.97%)	-	-	-	-	-	-	6 (1.08%)
50% SL-50% L	-	4 (2.63%)	-	-	-	-	-	4 (0.72%)
75% SL-25% L	-	19 (12.5%)	-	-	3 (17.64%)	6 (15.38%)	1 (12.5%)	29 (5.24%)
81.25%SL-18.75%L	-	2 (1.31%)	-	-	-	-	-	2 (0.36%)
87.5% SL-12.5% L	6 (2.97%)	23 (15.13%)	-	22 (26.19%)	3 (17.64%)	3 (7.69%)	-	57 (10.30%)
93.75% SL-6.25% L	-	2 (1.31%)	-	2 (2.38%)	1 (5.88%)	-	-	5 (0.90%)
SL (100%)	6 (2.97%)	24 (15.78%)	26 (46.42%)	14 (16.67%)	-	2 (5.12%)	-	72 (13.01%)
RCC (100%)	11 (5.44%)	9 (5.92%)	1 (1.78%)	3 (3.57%)	3 (17.64%)	-	-	27 (4.88%)
NBG (100%)	9 (4.45%)	-	3 (5.35%)	-	1 (5.88%)	-	-	13 (2.35%)
Pabna (100%)	-	-	1 (1.78%)	-	-	-	-	1 (0.18%)
Munshiganj (100%)	-	-	5 (8.92%)	-	-	-	-	5 (0.90%)
Total	202	152	51	84	17	39	8	553

[1]*NTRC, National Technical Regulatory Committee; HF, Holstein-Friesian; L, Local; SL, Sahiwal.*

Notably, the representation of different indigenous cattle varieties of Bangladesh (Red Chittagong, North Bengal Grey, Munshiganj and Pabna) in artificial insemination (AI) program was limited (8.31%) compared to the exotic pure breeds and their resultant crossbreds. The maximum and minimum insemination share occupied by DLS (43%) and American Dairy Limited (6%) respectively where BRAC and Milk Vita placed in intermediate position (17%) in the studied areas (Figure 1).

Challenges of crossbred cattle development

In the surveyed areas, 83% crossbred dairy cows were purchased from local market (Figure 2A) based on mainly phenotypic features and farmers' opinion on milk production performance and the proportion of homegrown cows were only 8%. Herdbook based record keeping system was almost absent in the studied areas.

Most of the dairy farmers were interested on more milk production (51%). Only 29% of the respondents gave opinion in favor of higher milk production with better resilience cows (Figure 2B). However, 20% farmers showed interest on higher inheritance of exotic blood (HF) along with more milk production. Breeding information of the cows in the surveyed farms was kept mostly by breeding AI technicians (89%). During insemination, the genotypes of the breeding bulls were decided mostly by the AI technicians (63%) where in 37% cases farmers took part in bulls' genotype selection process. Importantly, 83% farmers of the surveyed areas had no formal training on dairy cattle breeding and dairy farming (Figure 3). The majority of cattle (73%) had no major reproductive problems and the remaining 27% cows suffered from various reproductive problems or abnormalities. Among them, dystocia, low conception rate, abortion and retention of placenta were noteworthy with frequencies of 35, 30, 29 and 6%, respectively. In the low conception category, 70% animals were repeat breeder (Figure 4). The reason for repeat breeding was mainly unknown (46%).

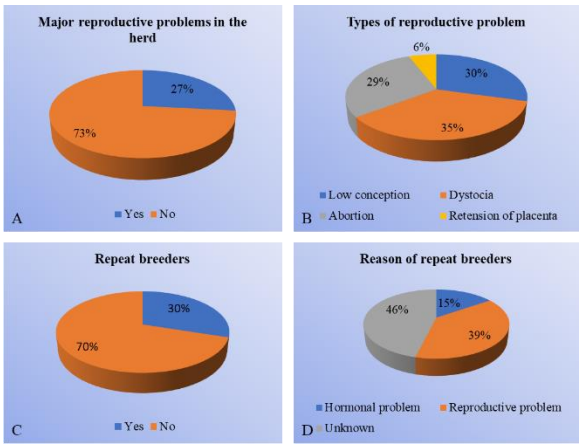

Figure 4: The major reproductive problems of crossbred cows in the studied area.

Discussion

The present study provided information on productive and reproductive performances of different graded HF×L cattle under semi-intensive production management in different areas of Bangladesh. In addition, investigations were made on existing cattle breeding practices, breeding bulls' genotypes and associated problems faced by farmers. The WFH of present study is significantly lower than the reported values of Fernandez et al. (2020) and Landarin et al. (2016) who found the average WFH as 354.2 kg and 307 kg, respectively in Girolando, a crossbred of 62.5% Holstein Friesian and 37.5% Gir cattle. Genotype and feeding practices might be the major attributing factors for this variation with present findings. The highest MBW was found in >HF75%×L<25% crossbreds (451.47±18.09 kg) while the lowest was in HF50%×L50% crossbred cattle (351.56±15.25 kg) and were slightly higher than the reported values of Khan et al. (2000) who found the MBW of different graded Local-Friesian (L×F) and L×F×F crossbreds as 340 and 395 kg, respectively.

The HF75%×L25% crossbred cattle performed better as compare to other three genotypes for AFH, AFC and PPHP and is comparable with the findings of Majid et al. (1995) and Rahman et al. (1998). The heifers are reared in abundance of quality forage with good management practice get early puberty and is one of the main demands of dairy farmers. AFC of HF50%×L50%, HF62.5%×L37.5%, HF75%×L25%, >HF75%×L<25% were 34.04±0.95, 34.63±1.81, 28.26±0.22 and 31.33±1.37 months, respectively. Asaduzzaman and Miah (2004) found that the AFC of HF×L and SL×L were 36.3±3.08 and 37.3±3.01 months, respectively and has close agreement with the results of the present findings. In general, it was also observed that intensive management practices reduced the AFC (Sarder and Hossain, 2001). Mureda and Zeleke (2007) mentioned several factors responsible for the advance or delay of AFH and AFC such as nutrition and management system, pre-pubertal growth rates, exotic blood levels, reproductive organ development, the onset of puberty and subsequent fertility. The highest PPHP was found 88.80±5.62 days in >HF75% L<25% crossbred cows and the lowest was in HF75%×L25% crossbred cows (66.47±1.10 days) and is similar with the findings of Rokonuzzaman et al. (2009) who found the shortest PPHP as 86.5±23.7 days in the L×F crossbred cows. Miazi et al. (2007) found the average PPHP of SL×L and HF×L cows to be 95.0±25.0, 90.0±13.42 days respectively and are agreed partially with this study. Proper management for crossbred cattle through providing adequate amount of concentrate and roughage and the proper heat detection might be contributory factors for the short interval from calving to conception.

In earlier studies, the average DMY of crossbred dairy cows was found 7.5±0.10 liters/day (Nahar et al., 1992), 7.64±1.74 liters/day (Mamun et al., 2015), 11.09 liters/day (Hasan, 1995) and 12.03 ± 3.73 liters/day (Kabir et al., 2009) and is in agreement with the current results. However, they did not mention the genetic proportions of the studied animals. Paul et al. (2013) reported that the average DMY of Sahiwal× Desi, Friesian×Desi and Jersey × Desi cows were 4.9±0.9, 6.0±1.0 and 5.7±0.9 liters, respectively in Sirajganj district and coincides only with DMY of HF50%×L50% crossbreds of this study. Famous et al. (2021) reported that the PMY per day for L×F crossbred cattle was 14.4 liters which is similar to the HF62.5%×L37.5% crossbreds of this study. The variations in DMY possibly incur with genotype, hormonal influences, feeding system, quality and quantity of the feed, irresponsible care taker, ambient temperature and humidity. The average lactation length for HF50%×L50%, HF62.5%×L37.5%, HF75%×L25%, >HF75%×L<25% were 8.54±0.33, 9.40±0.37, 9.08±0.24 and 9.67±0.39 months, respectively and is comparable with the findings of Hasan (1995) and Uddin et al. (2008) who reported the average LL varied from 256.3±24.37 to 284.69±1.64 days in Holstein-Local crossbred cattle of Bangladesh. In contrast, Alam et al. (2008) found a bit lower LL (217.9 ± 18.7 days) than this study in HF×L crossbred cattle. Taken together, genotypes of the animal, disease occurrence, managemental system, feeding, housing and nutritional supplement has great influence upon lactation length.

According to National Livestock Breeding Policy 2007 (NLDP, 2007), emphasis has given on selective and crossbreeding/up-grading program in cattle to meet up country's growing demand for milk and meat. However, the breeding practice scenario is quite different at field level, just performing haphazardly without any clear target. In total, 11 different crossbred combinations were identified in the NTRC certified breeding bulls. Therefore, it would be difficult to achieve the target of synthetic dairy cattle development using this heterogenous crossbred bulls. Numerous limitations have been identified in the studied areas regards to cattle breeding practices.

Among them, most probable reasons were unknown genotype of the cows, AI worker depended breeding practice, absence of Herdbook based record keeping, emphasis on only milk production trait and farmers' insufficient knowledge about breeding policy. The mismatches between genotypes and production environment, inappropriate recording and policy systems hampered crossbreeding program (Kebede et al., 2018). Bhuiyan et al. (2017) and Ojango et al. (2017) also stated that environment and genotype mismatch, trained manpower problem were the major challenges under smallholder dairy cattle crossbreeding in the tropics. The level of inheritance in the crossbreeds needs to be considered with 50% exotic blood for hassle free farming (Galukande et al., 2013). All of these above stated reports support the present findings. Farmers 'unwillingness in Herdbook based record keeping system on pedigree and performance and unplanned admixture of different breeds without prior information are major challenges for crossbred dairy cattle development in Bangladesh (Bhuiyan et al., 2015). Sultana (2018) identified several limitations on present cattle breeding practices in Bangladesh such as importation of inappropriate genetic material coupled with indiscriminate crossbreeding, weak infrastructure facilities, minimum promotion of indigenous cattle in artificial insemination program.

Reproductive disorders of dairy cattle are of great concern to producers due to their adverse effects on fertility and productivity. Mekonnin et al. (2015) found the prevalence of reproductive disorders in crossbred cattle as anestrus (37.8%), repeat-breeding (21.0%), dystocia (11.6%), retained fetal membranes (11.5%) and abortion (6.4%). In another study, Khan et al. (2016) reported that the incidence of anestrus, repeat breeding, retention of fetal membrane, abortion and dystocia was found to be 31.79, 24.61, 14.35,11.25 and 5.12% respectively. These results are more or less similar to the present study. In addition, Tulu et al. (2022) observed the three main reproductive disorders in their studied areas and the incidence rates were abortion (17.8%), stillbirth (4.8%), and dystocia (3.3%). Yohannes and Alemu (2019) reported that Dystocia, repeat breeder, retained fetal membrane, abortion; metritis, anestrous and uterine and vaginal prolapse were recorded with prevalence of 15.5, 8.1, 5.3, 4.5, 2.6, 2.3 and 1.0%, respectively. Tolosa et al. (2021) found the prevalence of mastitis (20.57%), repeat breeder (17.71%), retained fetal membrane (6.51%), uterine and vaginal prolapse (5.47%) and abortion (4.1%). All of these previous studies reported almost common reproductive problems with various degrees of frequencies and support the present findings. Altogether, improvement in management system, proper selection of bull and appropriate timing of AI for breeding, accurate heat detection, routine and periodical examination of cows, balanced feeding, and hygienic condition of the farm could reduce the aforementioned problems.

Conclusions

This study shows all considered productive and reproductive traits differed significantly ($P<0.05$) among the four different genotypes except BW and SPC. The present study identified several limiting factors for the current cattle breeding practices in the surveyed areas where heterogeneous breeding bulls with different genetic propositions, local market depended cows and heifer purchase, AI technicians depended breeding service and absence of any kind of record keeping system. Taken together, it may be concluded that production performance of 75%HF×25%L was superior compared to three other involved crossbred genotypes. However, it would be better to evaluate the performance of crossbred genotypes using large dataset for making a reliable conclusion.

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Authors Contribution

A Azad and MSA Bhuiyan conceptualize the research, designed the experiment, manuscript writing and editing; MA Mou and MFA Hridoy were involved in data curation and analysis. S. Azam and MA Safa participated in phenotypic data recording and AKFH Bhuiyan critically reviewed the manuscript

Data Availability

The data used in this research are within this manuscript.

Conflict of interest: The authors declare no conflict of interest.

Consent to Participate

The authors have given full consent to participate as per need.

Consent for Publication

The authors fully agreed to publish this article in Bangladesh Journal of Animal Science.

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