Research Article

Empirical Analysis on the Genotype-wise First Service Conception Rate of Local and Crossbred Cattle in the Field Level of Bangladesh

Auvijit Saha Apu[1]✉, Md. A. Saleque[2], Hiresh Ranjan Bhowmik[2], Arabinda Kumar Saha[3] and Md. Mozaffar Uddin Ahmed[3]

[1]Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]ACI Animal Health and ACI Genetics, Dhaka
[3]ACI Animal Genetics, Dhaka

ARTICLE INFO	ABSTRACT
	Artificial insemination (AI) is one of the most important tools for upgrading the cattle breed in our country. The present study was conducted to determine the conception rate of Local and Crossbred cattle of Bangladesh using field data. In this study, 78 AI service providers named as Livestock Assistants (LAs) having at least two years of work experience with ACI Animal Genetics were randomly chosen from 28 districts of the 8 divisions. Information was collected randomly from 417 selected farmers whose 417 cattle were inseminated in March 2022. The majority of the cattle raised by the farmers were crossbred (79% of the total cattle). These 417 cattle were inseminated using five different genotypes of sire's semen (Holstein Friesian 100%, Holstein Friesian cross, Sahiwal 100%, Sahiwal cross, and RCC). The study revealed that the overall conception rate of cattle was 70%. However, the rates of conception vary among the different genetic groups of cattle. Among the different groups, the RCC had the highest conception rate (100%) followed by the indigenous (74%), Sahiwal cross (72%), and Holstein Friesian cross (62%). Our study also revealed that, of the 30% of repeat cases, 17% required a second insemination, 7% a third or more insemination for getting pregnant and 6% of the cows failed to become pregnant. About 96% farmers received AI cards, but only 67% of them mentioned that they preserved those AI cards for future uses. In a nutshell, this study disclosed the genotype wise first service conception rate in Local and Crossbred cattle at the field level of Bangladesh.

Introduction

Livestock is one of the fastest growing industries in Bangladesh and significant growth of milk and meat have been observed over the last 20 years. In the past ten years, the number of cattle has only increased by 6%, while milk and meat production have increased by more than 155% (DLS, 2023) and it is primarily occurred as a result of the increased number of crossbred animals in our country.

Artificial insemination (AI) is one of the most important assisted reproductive technologies which have contributed in improving the cattle productivity. In Bangladesh, AI was introduced as an effective breeding tool at the beginning of 1960 with the objective of upgrading indigenous local cows. In 1960, Central Cattle Breeding station, Savar was established with the major objectives of fundamental research in livestock and to evolve one or two cattle breeds suitable for the country. Later, a cross breeding program was planned for upgrading the local cattle with the infusion of *Bos taurus* blood (Miah *et al.*, 2004). Currently, major AI services providers are Department of Livestock Services (DLS), Milk Vita, and 7 private sector stakeholders (BRAC, ACI, ADL, Lal Teer, Ejab Sajak and TDL). Among them DLS sold 42.33 lac doses of semen in 2022-2023, of which frozen semen 37.55 lac (88.7%) and liquid chilled semen 4.78 lac doses (11.3%) (DLS, 2023). A recent estimation shows that about 14 million doses of semen were used in 2022-2023 around the country and the current coverage under AI is about 70%- 75% (ACI, 2023).

The dairy cows play a vital role to improve the livelihood of poor and marginal people of Bangladesh. The conception rate of cows significantly impacts the

profitability of dairy production as a whole, which is a challenge for dairy industry across the world. The percentage of inseminated cows that become pregnant is a proxy for cow conception rate, determining their reproductive capacity and lifetime productivity (Souames and Berrama, 2020). Boosting dairy cow fertility and conception rates is crucial to ensure sustainable dairy production.   Now the major constraints of profitable dairy farming is low conception rate (CR)/pregnancy rate (PR), number of services required per conception, calving to next service interval, and poor heat detection before AI (Shamsuddin *et al.,* 2001; Paul *et al.,* 2011). In Bangladesh, CR of cattle using frozen semen is 57.3% (Das *et al.,* 2002). Shamsuddin *et al.,* (2001) reported higher conception rate (54%) in cows inseminated with frozen semen than that (37%) in cows inseminated with chilled semen. The average conception rate of local nondescript and crossbred cows with Holstein Friesian and Sahiwal breed were 42.5% and 45.2% to 53.1%, respectively (Shamsuddin *et al.,* 1997). However, a complicated combination of genetic and non-genetic factors affects dairy cows' ability to have excellent conception rates (Kathy, 2004).

AI program always demands to keep records of non-return rate, conception rate, service per conception and calving rate in order to properly evaluate the reproductive efficiency of cows, skill of the inseminators, semen quality and fertility of bulls. From this point of view, the present study was conducted to evaluate the conception rate of cows, effect of breed on conception rate, percentage of repeat breeding at field level in Bangladesh.

Materials and Methods

ACI has set up its own modern bull station and is now generating high-quality semen of Holstein Friesian (HF), Sahiwal (SL), and Red Chittagong Cattle (RCC) in compliance with the present breeding policy and other terms and conditions imposed by the Government.

Selection of livestock assistants (LAs), farmers and animals

In this study, 78 Livestock Assistants (LAs) who have at least two years of work experience with ACI Animal Genetics were randomly chosen from 28 districts of the 8 divisions. Thereafter, the record registers of LAs were taken and randomly chosen a month (March 2022) and also randomly taken 417 AI cases out of 1912. Our research team contacted all of the farmers (417) whose cattle (417) were inseminated in that month by the respective LA's (Table 1).

Table 1. Number of districts, LAs, farmers, and cows included in the survey

Name division	No. of district	No. of LA	No of farmers	No. of cows
Chattogram	2	7	39	39
Sylhet	3	6	24	24
Rajshahi	3	12	79	79
Khulna	5	12	54	54
Rangpur	2	7	16	16
Dhaka	6	14	126	126
Mymensing	3	13	64	64
Barishal	4	7	15	15
Total	**28**	**78**	**417**	**417**

Data collection

A well-structured questionnaire was developed by the expert team members for this study and pretested before data collection. Our research team monitored the selected farmers throughout a year and went door to door to collect data directly from the farmers. Finally, the data on conception rate (based on observed pregnancy) and other parameters were collected using the structured questionnaire. Farmers could readily confirm the pregnancy of their cows because data was collected after 9-10 months of insemination. So, in this study, conception rate was measured based on the confirmed pregnancy of the cows.

Cow's fertility is commonly measured by calculating percentage of cows that conceived after first service, and it is known as the conception rate (CR).
Conception rate (CR) =

$$\frac{\text{No.of cows/heifers became pregnant by 1st service}}{\text{No.of cows/heifers Inseminated}} \times 100$$

Statistical analysis

The collected data and information from field surveys, interviews, discussions and communication were scrutinized, classified, edited and coded. For analyzing the data, descriptive statistics such as sum, average and percentages were used to fulfil the objectives and to get the meaningful results using SPSS 23.0 software.

Results and Discussion

Size of herds and types of cattle raised by selected farmers

The survey revealed that 417 selected farmers raised 1912 cattle, including 417 cows for this study. The majority of the cattle raised by these farmers were crossbred (79% of the total cattle), and the average number of animals per farm was 4.6. In different divisions, the average herd size of cattle varies greatly (Table 2).

Among the 417 farmers that participated in the survey, more than 50% have 1-3 cattle, 23.3% have 4-5 cattle, and the remaining 26.1% have >6 animals (Table 3).

Table 2. Size of herds and types of cattle reared by selected farmers

Name of Division	No. of farmers	Total cattle	Average herd size	Total cross breds	Milking cows	Heifers	Others	Total local cattle	Milking cows	Heifers	others
Chattogram	39	257	6.6	242	122	8	112	15	12	1	2
Sylhet	24	165	6.9	140	56	13	71	25	16	0	9
Rajshahi	79	372	4.7	295	127	23	145	77	53	6	18
Khulna	54	204	3.8	149	52	17	80	55	38	2	15
Rangpur	16	82	5.1	63	26	4	33	19	11	0	8
Dhaka	126	421	3.3	333	127	41	165	88	54	15	19
Mymensing	64	344	5.4	233	89	12	132	111	67	12	32
Barishal	15	67	4.5	61	25	5	31	6	5	0	1
Total	**417**	**1912**	**4.6**	**1516**	**624**	**123**	**769**	**396**	**256**	**36**	**104**

Table 3. Number of farmers with average number of animals

Name of Division	Number of cattle							
	1-3	4-5	6-10	11-15	16-20	21-30	31- 50	Total
Chattogram	0	5	5	3	2	2	1	39
Sylhet	8	3	8	2	3	0	0	24
Rajshahi	31	26	17	4	0	1	0	79
Khulna	31	16	5	2	0	0	0	54
Rangpur	5	4	6	1	0	0	0	16
Dhaka	86	23	14	0	3	0	0	126
Mymensing	22	18	21	2	0	0	1	64
Barishal	7	2	5	1	0	0	0	15
Total	**211**	**97**	**81**	**15**	**8**	**3**	**2**	**417**

In a study, Saha *et al.* (2019) found that the crossbred cattle were 58% whereas Local cattle were 42%. Karim *et al.* (2020) reported that 70% farmers reared indigenous cattle and 30% reared crossbred cattle at Mymensingh district. Huque (2011) found that average number of cows per household varied from 1.75 to 2.47. On the other hand, in Rangpur district, Anowar *et al.* (2015) found that the average number of cow, bullock and calves were 1.20, 0.74 and 0.94, respectively. In Sylhet district, average number of native cattle and crossbred cattle were 3.31 and 0.12 in Jaintapur upazila and 4.09 and 0.06 in Balaganj upazila. The variations in the percentages of Local and crossbred cattle populations among the studies might be due to small sample size in a particular region which did not reflect the whole district or a division.

Breeds/Genotypes of inseminated cows

Among the 417 cows chosen, 159 were local cows, 148 were HF cross, 103 were SL cross, and 7 were RCC. In the current study, percentage of local cows, HF cross, SL cross, and RCC were 38.1%, 35.5%, 24.7%, and 1.7%, respectively. Among the inseminated 417 cattle, 71.2% were cows and 28.8% were heifers (Table 4).

Table 4. Breed of inseminated Cow/Heifer

Type/breed of animal	No. of heifer inseminated	No. of cow inseminated	Total number of cattle inseminated	% of cattle inseminated
HF cross	51	97	148	35.5%
SL cross	27	76	103	24.7%
Local	42	117	159	38.1%
RCC	0	7	7	1.7%
Total	120 (28.8%)	297 (71.2%)	417	100.0%

Sorowar *et al.* (2021) reported in their study that indigenous cattle, HF cross, SL cross and RCC were 47%, 25%, 21% and 7% respectively in their study areas. In a study, Adhikary *et al.* (2021) inseminated 35% Brahman×Indigenous, 32% Indigenous, 21% Friesian× Indigenous cows and 12% Shahiwal× Indigenous cows in three villages of Mymensingh districts. Shohiduzzaman *et al.* (2012) stated that they inseminated 44.44% Local cows, 30.56% Local x Holstein- Friesian cows, 25% Local x Sahiwal cows. Al-Amin *et al.* (2018) found that artificial insemination was performed in 1.36% pure Friesian cows, 4.38% Local, 90.18% Local × Friesian, 1.67% Sahiwal × Friesian and 2.42% Local × Jersey cows. On the other hand, Hossain *et al.* (2016) inseminated 62.05% Local cows, 2.23% RCC cows and 35.71% crossbred cows in Jessore district.

Breeds/types of semen used in artificial insemination
It was found that 5 types of semen (HF 100%, HF cross, SL 100%, SL cross, and RCC) were used to inseminate 417 cows. The number of semen used for insemination was highest in the case of HF cross and the lowest in case of RCC. The percentage of semen used in AI was 37%, 26%, 19%, 16%, and 2%, respectively in HF cross, SL cross, pure SL, pure HF and RCC (Figure 1).
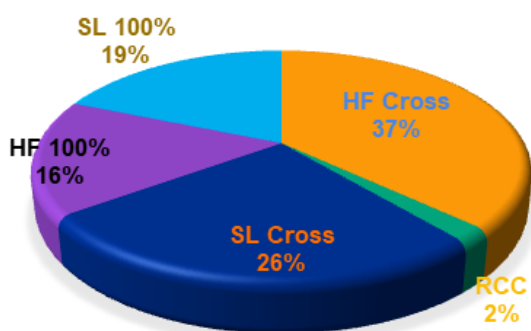

Figure 1. Semen of different breeds used for artificial insemination

Siddique *et al.* (2013a) conducted an experiment in peri-urban areas and found that 43.07% farmers prefer HF crossbred semen, 14.60% prefer SL, 39.41% prefer RCC and 2.92% prefer other genotypes. In Gaibanda district, Mondal *et al.* (2018) observed that among crossbred semen user, 80% farmers used Holstein

Friesian × Local, 14% used Sahiwal × Local and 6% used Jersey × Local. On the other hand, Habib (2021) found that 37.25% farmers preferred 50% Sahiwal-50% Local semen for their cow followed by 100% Sahiwal (20.59%), 75% HF-25% local (16.67%), 100% HF (4.90%), 87.5% HF-12.5% Local (2.94%), 50% HF-50% local (2.94%).

In another study, Jabbar *et al.* (2010) stated that 54%, 17%, 10%, 9%, 3%, 3% 2%, 1% and 1% farmers used HF, HF×SL, SL, HF× SN, HF × Pabna, Red Sindhi (SN), SN×RCC, HF× Jersey, SN×SL genotype respective for AI of their cow.

Conception rate
A total of 417 cows of different breed was inseminated with different types of frozen semen (5 genotypes) produced in ACI bull station. It was found that about 70% cows were pregnant by 1st time insemination using ACI produced frozen semen (Figure 2). According to Howlader *et al.* (2019), a first service conception rate above 60% normally indicates a good reproductive efficiency of a dairy herd. The average conception rate of cow recorded by several investigators was 54.9% (Khatun *et al.*, 2014), 62.86% (Sharifuzzaman *et al.*, 2015), 52.6% (Haque *et al.*, 2015), 59.3% (Khan *et al.*, 2015), 57.3% (Paul, 2010), 55.1% (Mollah, 2011) and 63.85% (Razi *et al.*, 2010). The results of the present study showed higher rate of conception than previous studies, with similar of Howlader *et al.* (2019) who found 72% conception rate of cows.

This study revealed that the conception rate of cows was 70% in first insemination and 30% repeat cases of which 17% required a second insemination, 7% required a third or more, and 6% of the cows failed to become pregnant (Figure 2). Khatun *et al.* (2018) stated that repeat cases were 35% in Jaintapur upazila) and 33% in (Balaganj upazila) of Sylhet district.

In a study, Siddique *et al.* (2013b) found that the overall first service conception rate was 50.7% in Local, SL crossbred and HF crossbred cows in Chittagong, Mymensingh, Khulna, Satkhira and Pabna districts. The success of AI in cows depends on several factors. The optimum conception rate is being achieved if good

quality of semen is used; the insemination is done at the most appropriate time in relation to the estrous period, and the skills of the technician in the procedure (Howlader *et al.*, 2019). Moreover, nutrition condition, sign of estrus, season (month of year) of AI, and their interactions had major influence on first service conception rate of cows (Siddique *et al.* 2013b).
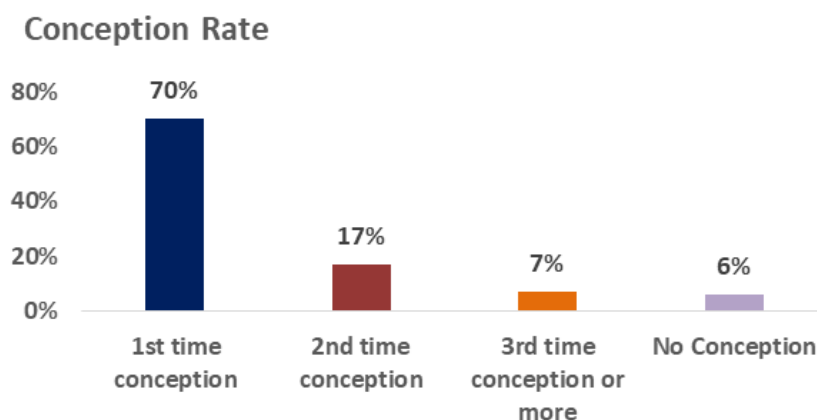
Conception Rate

Figure 2. Conception rate in successive insemination

Conception rates among various types/breeds of cows
This research revealed that breed had an impact on cow pregnancy rates. Although the average conception rate was 70%, the survey's findings indicated that it varied depending on the genotype of cows and the type of semen utilized (Table 5 and Figure 3). The conception rate in different cattle populations is presented in Figure 3. The average conception rate for local cows was 74%, for Sahiwal crossbred cow it was 72%, and for Holstein Friesian (HF) crossbred cows it was 62% (Table 6 and Figure 3). However, the average conception rate in RCC was greater (100%) than other groups. The higher percentage of conception rate in RCC might be due to small sample size (7 cows, or 2% of the sample).
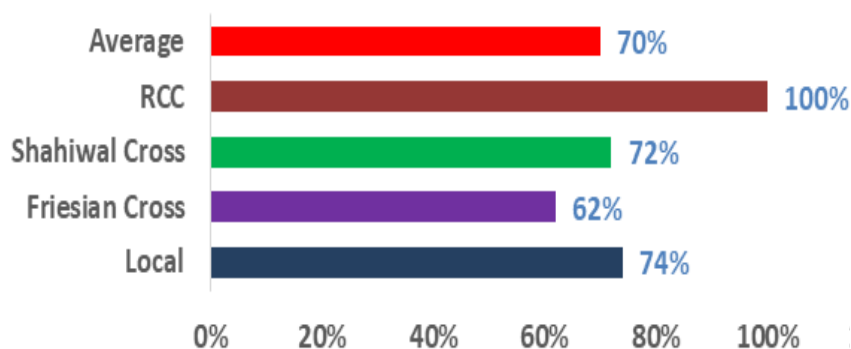

Figure 3. Conception rates among various genotypes of cows/heifers

The conception rates for all three studied populations (Local, HF cross, and SL cross) were higher than those found in earlier studies done by other authors. The variation among the genotypes was consistent with the research by Howlader *et al.* (2019), Sharifuzzaman *et al.* (2015), and Razi *et al.* (2010). These findings, however, differ from those of Khatun *et al.* (2014) and Khan *et al.* (2015).

According to a study by Razi *et al.* (2010), the conception rate varied among the studied cattle populations; 73% was recorded for the Local, 65% for SL, and 60% for HF cross. Howlader *et al.* (2019) also reported that the highest conception rate found in non-descriptive indigenous cows that differed significantly than the crossbred. Sharifuzzaman *et al.* (2015) found that the conception rate was highest (69.23%) in native cattle and intermediate (67.92%) in Sahiwal cross and lowest (57.22%) in Friesian cross. On the other hand, conception rate was the highest (64%) in native cattle and intermediate (57%) in Friesian cross and the lowest (53%) in Sahiwal cross reported by Khan et al. (2015). On the other hand, Khatun *et al.* (2014) reported that higher conception rate was in Holstein Friesian cross

(62.3%) followed by Local (52.9%) and Sahiwal cross (40%).

Additionally, it was shown in our study that the conception rate varied depending on the genotype of sire's semen used for artificial insemination. In all categories of cows, Sahiwal 100% semen was found to have the highest conception rate (77%) whereas HF 100% semen had the lowest conception rate (59%) (Table 5).

Table 5. Conception rate of different genotypes of cows using semen of different genetic groups

Types of Semen used	Conception rate				
	Local	HF Cross	SL Cross	RCC	Total
HF 100%	50% (14)	60% (53)	100% (1)	0% (0)	59% (68)
SL 100%	80% (20)	100% (1)	75% (57)	0% (0)	77% (78)
HF Cross	76% (58)	63% (94)	100% (2)	0% (0)	68% (154)
SL Cross	74% (66)	0% (0)	65% (43)	0% (0)	71% (109)
RCC	100% (1)	0% (0)	0% (0)	100% (7)	100% (8)
Total	**74% (159)**	**62% (148)**	**72% (103)**	**100% (7)**	**70% (417)**

Parentheses indicates the number of cattle inseminated

Farmer's opinion about semen of different companies
According to this study, 78% farmers believe that ACI semen is of more choice for artificial insemination due to its high conception rate, healthy calves, and other factors. Habib (2021) observed that 41.41% farmer in the northern part of Bangladesh preferred semen from BRAC, 30.30% from ACI, 22.22% from Govt. (Department of Livestock Services) and 6.06% from American Dairy Limited (ADL). Uddin *et al.* (2014) reported that farmers' access to artificial insemination was 63.6%, 21.2% and 15.2% to public and private, public and autonoumous and private and autonomous organization.

Record keeping
In AI activities, record keeping is crucial. Therefore, inquiries were made on their system for keeping records. Approximately 96% of farmers claim to have received their AI cards, but only 67% of them told that they kept the records for future use (Table 6).

Table 6. Response of farmers on record card receive and preserve issue

Respond by farmers	% of farmers received card	% of farmers preserve card
Yes	96.4% (402)	66.9% (279)
No	2.9% (12)	30.9% (129)
No Response	0.7% (3)	2.2% (9)
Total	**100.0% (417)**	**100.0% (417)**

Parentheses indicates the number of farmers

Milk production of inseminated cows
Based on 297 lactation records, about 4% of the respondents indicated that they received more than 20 liters of milk per day, whereas about 50% of the responses indicated that they received an average of less than 5 liters of milk per day (Table 7).

Table 7. Milk production of cows in previous lactation

Amount of milk production	Number of cows produced milk	% of the Total	% of the Response
Less than 5 Liters	143	48.1%	50.9%
5 to 10 Liters	98	33.0%	34.9%
11 to 15 Liters	19	6.4%	6.8%
16-20 Liters	9	3.0%	3.2%
More than 20 Liters	12	4.0%	4.3%
Non-Responsive	16	5.4%	-
Total	**297**	**100.0%**	**100.0%**

Rahman *et al.* (2013) observed that milk yield (kg/d) of Local, Holstein × Local, Sahiwal × Local, Sindhi × Local and Red Chittagong × Local cows was 2.37, 9.33, 3.00, 3.16 and 2.25, respectively. In another study, Solaiman *et al.* (2022) found that the average daily milk yield was 5.74 L in 25% Local-50% Friesian-25% Sahiwal, followed by 5.24 L from 25% Local-75% Friesian and 3.96 L from 50% Local- 50% Friesian cows. In a study with various

genotypes of cattle, Islam *et al.* (2017) found that the average milk yields per day were 1.64, 6.65, 5.92, 7.02 and 5.54 liter in Local, Local × Friesian, Local × Sahiwal, Local × Sahiwal × Friesian and Local × Jersey, respectively.

Conclusion

The findings of the present study indicate that 79% of the total cattle raised by the farmers were crossbred, and the average number of animals per farm was 4.6. HF cross semen was mostly chosen by the farmers for AI to their heated cows. The overall first service conception rate of cow was 70%. Conception rate varied among different genotypes of cows. Local cattle had the higher conception rate followed by Sahiwal and Friesian crossbred cattle in the field level. Out of the 30% repeat cases, 17% needed a second insemination, 7% needed a third or more, and 6% of the cows were unable to conceive. Approximately 96% of farmers received their AI cards, but only 67% of them preserved it for future use.

Acknowledgement

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