



Research Article

Quantifying AI Impact: Non-Return Rate Analysis of cows in Thakurgaon, Bangladesh

Md. Zahid Hossain¹, Md. Mahfuzul Haque², Md. Masud Parvej³, Hemayet Hossain³, Faija Sadia Pory⁴, Dipsana K.C.⁵ and Md. Imranuzzaman^{5*}

¹Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh; ²Department of Surgery and Theriogenology, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh; ³Department of Anatomy and Histology, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh; ⁴Department of Poultry Science, Faculty of Veterinary, Animal and Biomedical Sciences, Sylhet Agricultural University, Sylhet-3100, Bangladesh; ⁵Department of Agriculture and Environmental Sciences, Lincoln University, MO 65101, USA.

Abstract | The aim of this study was to determine the variables linked to the non-return rate (NRR) of dairy cows in terms of Artificial Insemination (AI) in Thakurgaon, Bangladesh. The study was carried out at Thakurgaon Sadar Upazilla Veterinary Hospital, Thakurgaon & some artificial insemination points of ACI Animal Health Co. Ltd., Ijab Farms, BRAC Agro LTD., American Dairy Ltd. with the help of their respective AI technicians during 1st July 2021 to 30th June 2022. Data of the 360 cow's inseminations performed during this period were gathered. Among them 250 cows didn't show any heat return signs with a success rate of 69.44%. The cows were inseminated between 12-48 hours of onset of heat. Semen from Brac Agro showed statistically significance ($p < 0.05$) difference among the others whereas semen percentages displayed not significant ($p < 0.05$) among three groups. In addition, age of cow and variety of breed are also representing statistically significance ($p < 0.05$) difference among the others as well as interrupted NRR. As the consistent growing livestock economy is grossly dependent on the success rate of AI, the Government should take much more research works to improve the non-return rate. Except for percentages of semen, this experiment concluded that breed variety, cow age, and source of semen all showed significant differences. Therefore, to improve the conception rate one should consider all factors related to the semen (source and percentage) and cow (age and breed) applying the practices recommended for the cow to conceive.

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***Correspondence** | Md. Imranuzzaman, Department of Agriculture and Environmental Sciences, Lincoln University, MO 65101, USA; Email: md.imranuzzaman597@my.lincolnu.edu

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Keywords | Artificial insemination, Conceive, Cows, Heat returns, Non-return rate, Semen



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Introduction

Bangladesh has a large population of livestock. As a result, dairy farmers have voiced concerns regarding animals that use AI having poor reproductive outcomes (Lemma and Kebede, 2011). The share of the livestock sub-sector in Gross Domestic Product (GDP) at constant price was 1.47%, and GDP growth rate was 3.47% in FY-2018-19. Among the sub-sector of the broad Agri-sector, the growth of the livestock sub-sector is the highest (Eco. Rev. 2019). Bangladesh's subsistence agrarian economy relies heavily on livestock (Raha, 2000). In Bangladesh, the livestock population consisted of 242.38 lakhs cattle (BBS, 2019). Data have shown that better reproductive and productive performances have been shown of Friesian cross-bred cows than other breeds of cows (Sarder, 2006). Nevertheless, compared to other Asian nations, the dairy industry in Bangladesh remained underdeveloped. Since the milk output of native cattle is lower than that of improved breeds, the number of crossbred cattle is growing daily as artificial insemination (AI) procedures proliferate throughout the nation (Rahman *et al.*, 1998). Using AI to crossbreed locally adapted cattle breeds with enhanced exotic dairy breeds, the nation has made tremendous efforts to increase the productivity of indigenous breeds. However, the success of such a program is unsatisfactory due to a variety of factors, including poor nutrition, poor husbandry practices, and a lack of infrastructure.

Increasing genetic superiority by selecting only the most desirable features to maximize earnings is the main goal of AI. Disease management, reduced breeding expenses, and potential losses related to preserving a natural sire all occur simultaneously. It has been used in initiatives pertaining to endangered wildlife in addition to domesticated livestock. The use of AI technology for frozen semen increases the rate of conception and enhances the genetic quality of animals, which benefits them later in their lives (Yadav, 2006).

According to ancient Arabian literature dated to roughly 1322 A.D., an Arab chieftain inserted a cotton wand into the mare's reproductive canal, and then used it to sexually stimulate the stallion and cause him to ejaculate. AI is typically credited to Spallanzani as its invention. His 1780 scientific studies describe the effective application of AI in canines. In 1899, Ivanoff from Russia was the first to do AI research on sheep, cattle, horses, and birds. According to Webb (2009),

he was the first to inseminate cattle successfully artificially. In Pakistan, artificial insemination was first used in the 1960s, but due to a lack of experienced personnel, modern procedures, funding issues, and some strategic mismanagement, the practice developed very slowly. The only methods by which we may enhance an animal's genetic potential and prepare it for future challenges is through breeding and artificial insemination (Ali, 1999).

With the establishment of Central Cattle Breeding and Dairy Farm, Savar (CCBS), AI program has been started in 1958 aiming to improve local cattle with exotic variety through crossbreeding suited to our local condition. German specialists worked at the Savar Dairy Farm from 1969 to 1982 to develop suitable breeds for draught and milk purposes. In addition, frozen semen of *Bos taurus* was imported from Germany, America, France, Australia and Japan for use and improvement of local cattle. Artificial insemination of cows is gaining popularity in the northern region such as Rangpur, Dinajpur, Thakurgaon following significant achievement in improving the breeding system. Officials stated that seven to eight years ago, the country was forced to rely on imports of deep-frozen sperm from abroad. But at present it has become capable of producing the semen according to its requirement (Eco. News, 2019).

The decline in reproductive efficiency has a negative impact on milk yield (Krpalkova *et al.*, 2016). The productivity of crossbred cows may differ from that of indigenous cows living in different geographical areas with harsh environmental conditions (Alam *et al.*, 2001).

Success with artificial insemination requires attention to detail in all areas of herd management. The manager's attitude is one of the most important factors affecting the program's success. Both a sound health program and good nutrition are requirements of any breeding program but become an absolute essential ingredient for artificial insemination (Selk, 2002). With the end of this view, the study will evaluate the success rate of AI in Thakurgaon district AI center as well as to know the effects of semen sources, semen percentages, age of cow, and breeds on conception rate which is the indicator of non-return rate.

Materials and Method

The study was carried out at Thakurgaon Sadar

Upazilla Veterinary Hospital, Thakurgaon & some artificial insemination points of ACI Animal Health Co. Ltd., Ijab Farms, BRAC Agro LTD., and American Dairy Ltd. with the help of their respective AI technicians during 1st July 2021 to 30th June 2022. Animals were inseminated during the specified time brought to clinic using frozen semen. The cows were inseminated between 12-48 hrs of onset of heat; data (history) obtained from the owners. The breeds were indigenous (Zebu) and their crosses with Holstein Friesian and Sahiwal. The semen was collected from the AD office of Regional AI Office, Dinajpur Region, Thakurgaon. An overview of the data for different variables (breed, age) of cows was shown in Table 1.

Table 1: Description of demographic variables of cows inseminated artificially.

Variable	Category level	No. of observation
Breed	Sahiwal Cross	345
	Friesian cross	10
	Ghir Cross	5
Age (Years)	2.5-3.5	70
	3.6-5	200
	5.1-9	90

Variable considered here as breeds and ages including different categorical level and specific number of observations.

Procedure for insemination

When inseminating, a plastic disposable glove was always worn. There was not much lube utilized. The gloved fingers were used to construct a cone, which was then placed inside the rectum. The rifle was neatly pushed into the vagina between the vulva's lips. There was a grating sensation when the pistol was carefully moved through the vagina to the cervix's surface. The pistol was kept under forward pressure as the cervix was adjusted to allow the gun to pass through the canal. At this point, the semen started to express, guaranteeing that most of the semen was expressed within the uterine body. Because removing the gun quickly can cause semen to flow back through the cervix and into the vagina, it was removed gradually from both the cervix and the vagina.

Pregnancy confirmation

Rectal palpation, as explained by Arthur (1964), was used to confirm pregnancy. To determine NRR, the pregnancy diagnosis results were noted. The asymme-

try of the horn, the fetus's palpation, and the slippage of the fetal membrane all served to confirm the pregnancy.

Data Collection and Analysis

Data was collected as the 18-24 day net reproductive length. Every study finding was documented, and statistical analysis was performed on the collected information. The experiment's data were entered into a Microsoft Excel® worksheet, where they were arranged and processed in preparation for additional analysis. ANOVA tables with a $p < 0.05$ level of statistical significance was used to examine the data.

Results and Discussion

The total number of 360 cattle who were inseminated, among them 250 didn't show any heat return signs with a success rate of 69.44% whereas 110 cows showed heat return (Figure 1, Table 2). This study was similar with Healy and Thomson (2013) (Healy *et al.*, 2013), in which they found a 39.6% success rate.

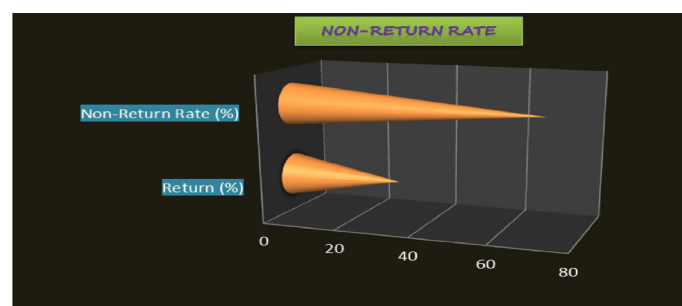


Figure 1: Non return rate and return rate of artificial insemination (AI) in cows (percentage).

Table 2: Measuring the success rate.

Total AI	Non-Return	Return	Non-Return Rate (%)
360	250	110	69.44

Out of a total of 360 cattle, 250 did not exhibit any evidence of heat return after being inseminated, resulting in a success percentage of 69.44%. The remaining 110 cows did show signs of heat return.

In the Table 3, there were 375 observations for BRAC Agro., 800 for Govt., 375 for ACI Animals, 100 for American Dairy, 125 for Lal Teer Ltd, and 25 for Ijab Farms. Semen from various sources may have diverse genetic characteristics. It is critical to pick semen from bulls with desired genetic features for your breeding objectives, such as milk production, fertility, health traits, and conformation. Quality control requirements for semen collection, processing, and storage may differ amongst vendors.

Table 3: *Effect of Semen Source on the Non-Return Rate.*

Semen Source	No. of observation	Mean $\pm$ SE	p-value
BRAC Agro.	375	3.73 ^b $\pm$ 0.22	0.04
Govt.	800	2.06 ^a $\pm$ 0.20	
ACI Animals	375	2.13 ^a $\pm$ 0.24	
American Dairy	100	2.00 ^a $\pm$ 0.30	
Lal Teer Ltd	125	2.40 ^a $\pm$ 0.30	
Ijab Farms	25	2.00 ^a $\pm$ 0.50	

Note: Mean with the same letter are not significantly different. Semen from Brac Agro showed statistically significance ($p < 0.05$) difference among the others.

The percentage of semen utilized can affect the amount of sperm delivered to the cow during insemination (Table 4). Higher semen percentages may result in more sperm being deposited into the reproductive canal, potentially improving the chance of successful fertilization. However, this study showed that there was no significant difference on non-return rate for semen percentages. It might be found that there was a small number of samples for proper statistical outcome.

Table 4: *Effect of Semen Percentage on the Non-Return Rate.*

Semen Percentage	No. of observation	Mean $\pm$ SE	p-value
70-80%	1400	2.04 ^a $\pm$ 0.23	0.96
81-87%	300	2.00 ^a $\pm$ 0.23	
87.5-100%	100	2.00 ^a $\pm$ 0.30	

Mean with the same letter are not significantly different p-value showed not statistically significance on success rate of AI in case of semen percentage used by the farmers.

This study (Table 5) was similar with Alam *et al.* (2001), following their explanation, maturity of cow depends on age which has significant impact on conceiving by insemination in animal. Calving to first insemination refers to a cow's ability to show estrus, whereas the NRR refers to a cow's ability to conceive when inseminated (Ben Jemaa *et al.*, 2008). The average days lost during voluntary and involuntary waiting times are included in this timeframe. A brief voluntary waiting period may result in a reduced first conception rate. The most powerful factor in inhibiting normal ovarian activity is postpartum negative energy balance, especially if the cow's body condition score is not adequate.

Table 5: *Effect of age of cow in AI success or Non-Return Rate.*

Age (Years)	No. of observation	Mean $\pm$ SE	p-value
2.5-3.5	350	1.92 ^a $\pm$ 0.27	0.025
3.6-5	1000	3.32 ^b $\pm$ 0.23	
5.1-9	460	2.17 ^a $\pm$ 0.22	

The means in age group of 3.6-5 was displayed significantly ($p < 0.05$) difference among the others group.

When compared to other breeds, Sahiwal crosses have demonstrated remarkable performance in non-return rates, demonstrating their better reproductive efficiency and adaptability. Their success can be attributed in large part to their perseverance and genetic purity, which they received from the Sahiwal bloodline (Table 6). In terms of reproductive performance, non-return rates are often lower in Friesian crosses and Ghir breeds than in Sahiwal crosses. There are several characteristics specific to each breed that account for this disparity. Despite their reputation for producing large amounts of milk, Friesian crosses frequently have problems with adaptation and fertility. Since Friesian genetics originated in temperate climates, they might not be adapted to survive in the more desert and harsh environments where Sahiwal crosses do well. Howlader and Rahman (2019) (Fryer *et al.*, 2019) found that there was a significant likelihood of a poor conception rate in crossbreeding scenarios.

Table 6: *Effect of Breed on the Non-Return Rate.*

Breed	No. of observation	Mean $\pm$ SE	p-value
Friesian Cross	345	3.03 ^b $\pm$ 0.14	0.023
Sahiwal Cross	10	4.10 ^a $\pm$ 0.35	
Ghir Cross	5	1.09 ^c $\pm$ 0.47	

The means of Sahiwal has been highly significant among the others in this evaluation.

Conclusions and Recommendations

Non-return rate is very significant to determine the conception rate and AI success. To optimize conception rates and AI success, it is needed to consider factors which related for affecting heat return. This experiment concluded that variety of breed, age of cows, sources of semen showed significant difference except percentages of semen. Since the success rate of AI is largely dependent on the steadily expanding

livestock economy. To improve the conception rate and non-return rate, farmers should use the considerations and techniques recommended for the cow to conceive, considering all aspects pertaining to the cow (age and breed) and semen (source and percentages). Therefore, the following consideration should be taken by farmers like selecting cows that are of optimal reproductive age and breed, known for higher fertility rates, is fundamental. Obtaining semen from superior, genetically superior bulls has a big impact on the success of conception as well as the sources of semen should be maintained by approved storages consideration.

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Novelty Statement

Bangladeshi dairy farmers are particularly concerned about the poor reproductive outcomes resulting by a low AI rate. A successful AI is continually dependent on a number of factors. The goal of this study was to estimate the conception rate and evaluate all parameters related to the semen (source and proportion) and cow (age and breed), allowing dairy farmers to raise the AI rate of dairy cows.

Author's Contribution

Md. Zahid Hossain: Field work, data collection, Writing – original draft. Md. Mahfuzul Haque: Writing – review & editing. Md. Masud Parvej: Writing – review & editing. Hemayet Hossain: Writing – review & editing. Faija Sadia Pory: Writing – review & editing. Writing – original draft. Dipsana K.C.: Writing – review & editing. Md. Imranuzzaman: Writing – review & editing. Writing – original draft, Supervision, Methodology, Conceptualization.

Conflict of interest

The authors have declared no conflict of interest.

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