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Conception Rate of Non-descript Zebu Cows and its Attributing Factors in Bangladesh

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ABSTRACT

Ensuring a promising conception rate of non-descript zebu cows maybe an appropriate approach for cattle development and rural livelihood enhancement in Bangladesh. The study was designed to determine the factors affecting conception rate of non-descript local zebu cattle (n = 307) under Artificial Insemination (AI) program using frozen semen. The demographic factors were recorded by interviewing the farmers. All cows were examined for pregnancy diagnosis by rectal palpation of genital tract at 60-80 days post AI. The overall conception rate of zebu cows was 57.7% and the required service per conception was 2.19. The conception rate in cows that received 2nd and 3rd service was significantly ($p<0.05$) higher than that of 1st service. The conception rate in cows inseminated within 8-12 h after the start of standing oestrus was significantly ($p<0.05$) higher than the cows inseminated after 12 h of standing oestrus. Breed of semen donar bulls did not affect significantly the conception rate of zebu cows. The conception rate in cows that received insemination at ≥10 months post-calving was significantly ($p<0.05$) higher than that of ≤4 months. The conception rate was the highest in cows inseminated at parity 1 and 2 and in cows fed with combination of roughages, concentrate and grazing. Zebu cows of 4-6 years age and yield >1.5 L milk/day had significantly ($p<0.05$) higher conception rate than others. It is concluded that conception rate of non-descript indigenous zebu cows is influenced by postpartum insemination interval, interval from estrus to AI, parity, feeding practice, milk yield and age of zebu cows.

Key words: Conception, AI, frozen semen, zebu cow, Bangladesh

INTRODUCTION

About 90% of total 24.5 million cattle are of non-descript indigenous in origin (Zebu cattle) along with 10% crossbred constitute national cattle herd of Bangladesh (Kamal, 2010). Zebu cattle are distributed throughout the country and in all agro-ecological (30) zones of Bangladesh (ILRI., 2004). It is well known that the reproductive potentiality of the zebu (indigenous) cows (*Bos indicus*) is very poor in comparison to those of different pure breeds. Zebu cows *Bos indicus* which show weak oestrus signs for a shorter duration than *Bos taurus* cows (Dawuda *et al*., 1989; Fitzpatrick, 1994). Various efforts have been made in the recent past in Bangladesh to improve the reproductive potentialities of indigenous zebu cows through crossbreeding or by upgrading program with different pure breeds (Rutledge, 1997). On the other hand, reproductive efficiency of cow is inseparably associated with the profitability. It is well recognized that fertility is one of the key drivers of profitability at herd level in dairy enterprises. This places an increased emphasis

on the need to understand factors that affect fertility, encompassing both herd level management factors (such as oestrus detection and nutrition) and individual cow factors (such as clinical or subclinical disease events and genetics) (Hudson, 2011). Dillon (2012) stated that improved reproductive performance at farm level will be achieved through the application of an optimum breeding management programme, good herd nutritional status (body condition score), increased number and quality of replacements, maintaining good herd health status and the use of genetically superior AI bulls. The major constraints of reduced efficiency of dairy cattle in Bangladesh are low conception rate, high number of services per conception, prolonged calving to first service interval, prolonged days open and poor heat detection (Alam and Ghosh, 1988; Shamsuddin *et al*., 2001). Siddiqui *et al*. (2013) reported that Body Condition Scores (BCS), heat detection signs, months of AI and their interactions had the greatest effects on first service conception rate in cows. It is likely that the post-AI conception rate of zebu cows may be influenced by different factors including time interval between oestrus and insemination, semen donor, interval between calving to AI, feeding practice, parity, milk yield and age of cattle.

Different factors were reported to affect the conception rate and fertility of cows/heifers reared under AI system (Woldu *et al*., 2011). Factors related to the cow and its environment/management affects the fertility of dairy cows (Lopez-Gatius, 2013; Muller *et al*., 2014). Poor feeding practices, lack of reproductive health management and diseases have been demonstrated as the causes of poor fertility in Bangladesh (Ghosh *et al*., 1993). Most of the previous studies in Bangladesh used various breeds of cows and data on reproductive performances of exotic and crossbred cows are abundantly available but they are very limited in case of indigenous cattle, because indigenous cattle has not yet been reared under close monitoring system. Indigenous cattle are reared scatteredly in the rural farmer's house because of which it is very difficult to get information due to poor awareness of the farmers. A comprehensive study on reproductive traits of indigenous zebu cattle is essential for improving the breeding efficiency and to formulate selection and breeding strategy. It is also an important tool of a breeder to evaluate the factors affecting the reproductive traits of indigenous cattle of Bangladesh. Therefore, it seems rationale to investigate the probable factors that may influence the conception rates of our local zebu cows under AI program using frozen semen. The present study was undertaken to determine the effects of number of services, time interval between oestrus and insemination, semen donor, postpartum insemination interval, parity, feeding practice, milk yield and age of animals on conception rates of non-descript local zebu cattle in Bangladesh.

MATERIALS AND METHODS

A total of 307 non-descript local zebu pubertal female cattle (heifers = 102, cows = 205) brought to Veterinary Hospital for artificial insemination were randomly included in this experiment. According to the owners of the cattle, routine deworming and vaccination were not in practice for these cattle.

Determination of age, body weight and parity of animals: The age of inseminated cattle was determined by observation of teeth eruption according to eruption chart of Rahman *et al*. (2004). The age of inseminated cattle ranged from 30-108 months. The body weight of inseminated cattle was determined by the formula of Rahman *et al*. (2004). The body weight of animals ranged from 120-200 kg. The parity of inseminated cattle was determined by interviewing the farmers. The parity of cattle ranged from 0-5.

Housing and feeding of animals: The cows were housed in rearing sheds only at night. At day time, most cattle were tied up. Most cattle were fed with paddy straw and greengrass collected from various places. Approximately 5-10 kg roughages were given to each animal daily. Some cattle were grazed daily for 1-2 h in the open field and road sides. Some cattle feed were also supplemented with 500-750 g concentrate daily. The concentrates were mainly rice polish, wheat bran, oilcake and common salt. All cattle had free access to drinking water.

Milking and suckling of animals: All cows were milked by hand milking keeping calves at feet of mother. Most of the cows were milked once daily in the morning. Some cows were also milked twice daily at 8 h interval. The amount of daily milk yield per cow was determined by interviewing the farmers at the day of insemination. The daily milk yield at the day of insemination ranged from 0.5-3 L. In most cases, calves were allowed to suckle freely at day time. Some calves were allowed to suckle only during milking time after 3 months of age which was regarded as restricted suckling.

Oestrus detection and Artificial Insemination (AI): The farmers detected the oestrus of inseminated cattle on the basis of clinical manifestation of oestrous signs. All cattle were brought to the Veterinary Hospital for insemination by walking from 1-7 km distance. The cattle were inseminated by trained AI technician using frozen semen collected from Central Cattle Breeding Station, Savar, Dhaka, Bangladesh. The interval between detection of oestrus and AI ranged from 8-24 h which was determined by interviewing the farmers and AI technicians.

Breeds of semen donor: The frozen semen of 3 semen donors was randomly used for insemination of cattle by a single AI technician. The breed of semen donor was determined by checking the name of breed printed on the semen straw or by checking the semen register.

Determination of non-return of oestrus and pregnancy: All inseminated cattle were checked by the farmers and in some cases by the investigator for presence or absence of oestrous signs at 20-22 days post AI. The cattle which returned to oestrus at 20-22 days post AI were inseminated again by same technician. The cattle which were non-returned to oestrus at 20-22 days post AI were examined for pregnancy diagnosis by the investigator by per rectal palpation of genital tract at 60-80 days post-AI.

Study approaches: In experiment 1, the effect of number of services on conception rate of zebu cattle was determined. The conception rates were compared among cows that received 1st, 2nd and 3rd service for conceptions. In experiment 2, the effect of interval between oestrus and insemination on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination at 8-12, 13-18 and 19-24 h interval between oestrus and insemination. In experiment 3, the effect of semen donor on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination with semen from 3 different bulls such as 75% Holstein-Friesian X local, 50% Holstein-Friesian X local and 50% Holstein-Friesian X Sahiwal. In experiment 4, the effect of interval between calving and insemination on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination at $\leq$4, 5-9 and $\geq$10 months interval between calving and insemination. In experiment 5, the effect of parity on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination at

parity-0, parity-1, parity-2 and parity-3 to 5. In experiment 6, the effect of feeding practices on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination under 4 different feeding practices such as roughages, roughages+grazing, roughages+concentrate and roughages+concentrate+grazing. In experiment 7, the effect of daily milk yield on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination with 3 different milk yields such as ≤1.0, 1.5-2.0, 2.5-3.0 L. In experiment 8, the effect of age on conception rate of zebu cattle was determined. The conception rates were compared among cows that received insemination at 4 different ages such as 30-36, 37-48, 49-72 and 73-108 months.

Data analysis: The data generated from this study were entered in Microsoft Excel Worksheet and descriptive statistics were performed. The conception rate in different experiments was expressed as percentage. Descriptive statistics was performed to calculate the mean, percentages of conception rate using frozen semen. The data were analyzed by ANOVA followed by Z test using SPSS software version 17. The variation in conception rates was considered significant when the p-value was less than 0.05.

RESULTS

Experiment 1: Effects of number of services on conception rate of indigenous zebu cattle are presented in Table 1. The overall conception rate of cows was 57.7%. The conception rate with respect to receiving different number of services ranged from 55.1-68.4%. The conception rate in non-descript zebu cows that received 2nd and 3rd service was significantly ($p<0.05$) higher than that of 1st service. Moreover, the number of services per conception was 2.19.

Experiment 2: Effects of interval between oestrus and AI on conception rate of indigenous zebu cattle are presented in Table 2. The conception rate with respect to different time interval between oestrus and AI ranged from 34.6-71.1%. The variation in conception rates between cows that received insemination at different time interval was significant ($p<0.05$) and the highest conception rate was found in cows that received insemination at 8-12 h interval between oestrus and AI.

Experiment 3: Effects of semen donors on conception rate of indigenous zebu cattle are presented in Table 3. The conception rate with respect to different semen donors ranged from 52.4-59.0%. Though the variation in conception rates between cows that received insemination from semen of

Table 1: Effects of number of services on conception rate in indigenous zebu cows

Service	No. of cows inseminated	No. of cows conceived	Conception rate (%)
1st	245	135	55.1[b]
2nd	43	29	67.4[a]
3rd	19	13	68.4[a]
Total	307	177	57.7

Total service = 388, service per conception = 2.19, [a,b]Values with superscript within same column differed significantly from each other ($p<0.05$)

Table 2: Effects of interval between oestrus and AI on conception rate in indigenous zebu cows

Duration from standing oestrus to AI (h)	No. of cows inseminated	No. of cows conceived	Conception rate (%)
8-12	166	118	71.1[a]
13-18	89	41	46.1[b]
19-24	52	18	34.6[c]

[a,b,c]Values with superscript within same column differed significantly from each other ($p<0.05$), AI: Artificial insemination

Table 3: Effects of breed of semen donor on conception rate in indigenous zebu cows

Semen donor type	No. of cows inseminated	No. of cows conceived	Conception rate (%)
75% Holstein-Friesian X Local	217	128	59.0
50% Holstein-Friesian X Local	21	11	52.4
50% Holstein-Friesian X Sahiwal	69	38	55.1

Conception rates with respect to different semen donors did not differ significantly from each other (p>0.05)

Table 4: Effects of interval from calving to AI on conception rate in indigenous zebu cows

Interval from calving to AI (months)	No. of cows inseminated	No. of cows conceived	Conception rate (%)
≤4	29	12	41.4[b]
5-9	97	55	56.7[a]
≥10	181	107	59.1[a]

[a,b]Values with superscript within same column differed significantly from each other (p<0.05), AI: Artificial insemination

Table 5: Effects of parity on conception rate in indigenous zebu cows

Parity	No. of cows inseminated	No. of cows conceived	Conception rate (%)
0	102	52	50.9[b]
1	112	71	63.4[a]
2	68	42	61.7[a]
3-5	25	12	48.0[b]

[a,b]Values with superscript within same column differed significantly from each other (p<0.05)

Table 6: Effects of feeding practice on conception rate in indigenous zebu cows

Pattern of feeding practice	No. of cows inseminated	No. of cows conceived	Conception rate (%)
Roughages	132	66	50.0[b]
Roughages+Grazing	49	28	57.1[b]
Roughages+Concentrate	56	36	64.3[a]
Roughages+Concentrate+Grazing	70	47	67.2[a]

[a,b]Values with superscript within same column differed significantly from each other (p<0.05)

different bulls was not significant (p>0.05), the highest conception rate was found in cows that received insemination with semen of 75% Holstein-Friesian X Local bull.

Experiment 4: Effects of interval from calving to AI on conception rate of indigenous zebu cattle are presented in Table 4. The conception rate with respect to different length of calving to AI interval ranged from 41.4-59.1%. The variation in conception rates between cows that received insemination at different intervals from calving to AI was significant (p<0.05) and the significantly higher conception rate was found in cows that received insemination at ≥10 months of calving than others.

Experiment 5: Effects of parity on conception rate of indigenous zebu cattle are presented in Table 5. The conception rate with respect to different parities ranged from 48.0-63.4%. The conception rate in cows that received insemination at parity 1 and 2 was significantly (p<0.05) higher than that of parity 0 and parity 3 to 5.

Experiment 6: Effects of feeding practices on conception rate of indigenous zebu cattle are presented in Table 6. The conception rate with respect to different feeding practice ranged from 50.0-67.2%. A significant (p<0.05) variation was found in conception rate of cows under different feeding practices and the highest conception rate was found in cows fed with combination of roughages, concentrate and grazing.

Experiment 7: Effects of milk yield on conception rate of indigenous zebu cattle are presented in Table 7. The conception rate with respect to different milk yield ranged from 43.6-62.6%. There was

Table 7: Effects of milk yield on conception rate in indigenous zebu cows

Milk yield	No. of cows inseminated	No. of cows conceived	Conception rate (%)
≤1.0 L	39	17	43.6[b]
1.5-2.0 L	195	122	62.6[a]
2.5-3.0 L	73	42	57.5[a]

L: Liter, [a,b]Values with superscript within same column differed significantly from each other (p<0.05)

Table 8: Effects of age of animals on conception rate in indigenous zebu cows

Age group (months)	No. of cows inseminated	No. of cows conceived	Conception rate (%)
30-36	91	50	54.9[b]
37-48	93	55	59.1[b]
49-72	86	58	67.4[a]
73-108	37	14	37.9[c]

[a,b,c]Values with superscript within same column differed significantly from each other (p<0.05)

a significant (p<0.05) difference in conception rates between cows with different daily milk yield and zebu cows yield >1.5 L milk/daily had significantly (p<0.05) higher conception rate than cows yield ≤1.0 L milk daily.

Experiment 8: Effects of age of animals on conception rate of indigenous zebu cattle are presented in Table 8. The conception rate with respect to different age of cowsranged from 37.9-67.4%. A significant (p<0.05) variation in conception rates between cows of different ages was found and the highest conception rate was in cows of 49-72 months age.

DISCUSSION

In Bangladesh, around the year a large number of animals remain barren or unproductive having exposed many times for natural mating or artificial insemination and become a burden for the farmers (Kamal, 2010). The main constraints of cattle reproduction in Bangladesh is prolonged postpartum intervals to conception and low conception rate, which were the results of inefficiencies in the management of nutrition, detection of oestrus and Artificial Insemination (AI) services (Shamsuddin *et al*., 2001). Despite the wide application and success of AI throughout the developed world, the success rate in developing countries is still low owing to a number of technical, system related, financial and managerial problems (Azage *et al*., 1995). Different factors were reported to affect the conception rate and fertility of cows/heifers reared under AI system (Woldu *et al*., 2011). It is considered that the fertility potential is equal to bull+cow+inseminator+environment. The present study was undertaken to determine the effects of number of services, time interval between oestrus and insemination, semen donor, interval between calving to AI, parity, feeding practice, milk yield and age of animals on conception rate of non-descript local zebu cattle under AI program using frozen semen in Bangladesh.

In the present study, the overall Conception Rate (CR) in nondescript local zebu cattle of Bangladesh received insemination with frozen semen was 57.7%. This is in agreement with the previous study done by Khan (2008) who found 59.3% conception rate in cows that received AI using frozen semen. Moreover, the present study demonstrated that the conception rate in cows that received 2nd and 3rd service was significantly (p<0.05) higher than that of 1st service (Table 1). The present finding on first service conception rate is in agreement with the earlier study by Shamsuddin *et al*. (2001) who obtained 54.9% first service conception rate using frozen semen in Bangladesh. Moreover, Freer (1981) recorded a conception rate of 43 and 76% for cows inseminated artificially at first and second cycle, respectively. The variation in conception rates among studies might be due to variations in semen (chilled vs. frozen) and breed of cattle (local

zebu vs. temperate breed) used in different studies as Habib *et al*. (2010) reported that CR depends on different genetic and non-genetic factors as reproductive health of the cow, semen quality, time of insemination, efficiency of inseminator etc.

To determine the efficiency of an AI program, service per conception is used as a reproductive parameter throughout the World. In the present study, the number of services required for each conception was 2.19. Khan *et al*. (2015) also recorded the same required service per conception for local zebu cows and also found genotypic variation in their observation (for Local cows 2.27, for Friesian Cross 1.56 and for Sahiwal Cross 1.79). Contrasting to the present study, Kale *et al*. (1988) reported requirement of 1.5-3.0 services per conception in organized farms in India. The variation in required number of services per conception among studies might be due to variations in management and nutrition of cows and agro-climatic conditions in different studies. Moreover, Shiferaw *et al*. (2003) reported that cows with reproductive disorders required more services per conception and had longer intervals from calving to first service and also to conception and Tadesse and Zelalem (2003) also noted a decrease in the number of service per conception required for cows supplemented with high level of protein.

The present study established that the conception rate in zebu cows is influenced by interval between oestrus and insemination as evidenced by significantly ($p<0.05$) higher conception rate (71.1%) in cows that received insemination at 8-12 h interval than that of 13-18 and 19-24 h counterparts (46.1 and 34.6%, respectively) (Table 2). Contrasting to the present study, Gonzalez (1981) reported the highest (62.5%) conception rate when insemination was done at 12-18 h after the onset of oestrus. The reason for variation in conception rates between studies might be due to differences in sample size, time of insemination and genotype of semen donar and cows used in different studies.

It was revealed that the conception rate in zebu cows was not influenced by the semen donor (Breed of bull) as evidenced by no significant variation in conception rates was observed in our study (Table 3). Contrasting to the present study, Shamsuddin *et al*. (2001) reported variation in conception rate of cows in seminated using semen from different crossbred bulls. Further, conception rate of cows may vary on the basis of type of semen used for insemination. Cows inseminated with frozen semen had significantly higher conception rate (58.2%) than those received insemination with chilled semen counterpart (35.9%) (Bhuiyan *et al*., 1999). Although the conception rate of cows with respect to semen type (frozen vs. chilled) was not compared, the conception rate of zebu cows obtained in the present study using frozen semen was similar to that was obtained in previous study (Bhuiyan *et al*., 1999). Moreover, the conception rate also affected by actual insemination technique potentiality of AI technician as faulty insemination technique (improper placement of the semen) is a major factor causing low conception rate in many herds.

A longer interval from calving to insemination is associated with higher conception rate (Zu and Burton, 2003). The conception rate in zebu cows was also influenced by the interval from calving to AI (postpartum insemination interval) in present study as evidenced by the significantly ($p<0.05$) higher conception rate in cows that received insemination at $\geq$10 months post-calving than that of $\leq$4 months (Table 4). This may be explained by the fact that at $\geq$10 months post-calving, most of the cows were dry and had minimum or no suckling resulting in higher conception rate. Negative effect of suckling on conception rate has been documented by Shamsuddin *et al*. (2001). The reason of negative effect of suckling on conception rate may be explained by the fact that suckling inhibits the GnRH and LH secretion in animals (Jainudeen and Hafez, 1993). Therefore, once-daily suckling is a successful management regimen for reducing the length of the postpartum interval to estrus and conception in cows (Bluntzer *et al*., 1989).

The conception rate in cows was influenced by the parity of cows as evidenced by the significantly ($p<0.05$) higher conception rate in cows at 1st and 2nd parity than that of cows at 3rd to 5th parity counterpart (Table 5). In the present study, the maximum recorded parity of cows was 5. Our observation is similar with Mufti *et al*. (2010). They observed that the conception rate of cows delivered 2nd and 3rd calves (parity 1 and 2) was higher than other parities in Red Chittagong cows. Contrasting to the present finding, Khan (2008) reported higher conception rate in cows at second and third parity than that of cows at zero parity (nulliparous). Moreover, Barcellos *et al*. (1996) reported a higher conception rate in multiparous cows than that in primiparous cows. The differences in conception rates with respect to parities among studies might be due to differences in breeds of cows and semen donar used and feeding practice, general and reproductive management, disease condition and agro-climatic condition of countries where the investigations were conducted.

Feeding practice influences the conception rate of cows and it was proved in our study. The significantly ($p<0.05$) higher conception rate was in cows fed with a combination of roughages, concentrate and grazing than that of cows fed with only roughages (Table 6). The present finding indicated the importance of daily supplementation of some concentrate in feed of dairy cows. It is likely that cows fed with a combination of roughages, concentrate and grazing received more balanced diet than cows received only roughages. The feeding practices of animals are finally reflected by the Body Condition Scoring (BCS) of the animals. Providing adequate quantity of balanced diet to animals will help to gain good BCS resulting in satisfactory conception rate. Higher conception rate in cows with good BCS than that in cows with poor BCS has been documented by Shamsuddin *et al*. (2001) in Bangladesh. Lopez-Gatius (2013) reported that poor nutrition or the loss of the body reserves (negative energy balance) affects the fertility of cows. The cows deficient in adequate quantity of balanced feed had reduced pituitary responsiveness to a GnRH challenge (Nolan *et al*., 1988). Thus providing feed with combination of roughages, concentrate and grazing in the present study might have contributed to proper functioning of reproductive hormones resulting in good conception rate.

Daily milk yield has a noticeable stimulus on conception rate of animals. In present study, the significantly ($p<0.05$) higher conception rate was in cows yielding 1.5-3.0 L milk day than cows yielding ≤1.0 L day (Table 7). Similarly, Shamsuddin *et al*. (2001) obtained lower conception rates in low yielding (≤1.0 L) cows than that of high yielding (>1 to 16 L) cows counterpart. The positive effect of high milk yield on conception rate may be explained by the fact that the high yielding cows received more attention, received balanced feed and were reared under good management (Shamsuddin *et al*., 2001).

The effects of age on the fertility of cows and bulls are difficult to assess, since they are complicated by so many other factors. Environmental factors such as season of the year, management practices and nutritional status frequently affect one age group more markedly than other. The conception rate of zebu cows was influenced by the age of animals in the present study. This was indicated by significantly ($p<0.05$) higher conception rate in cows of 49-72 months age than that of cows of 30-36 and 73-108 months counterpart (Table 8). Khan *et al*. (2015) also found the highest conception rate was in between 3.5-5 Y of cows. Moreover, Gwazdauskas *et al*. (1975) found that conception rate declined with increasing age of animals. Nevertheless, the reason for low conception rate in young cows in the present study may be explained by the fact that these cows may have suffered more from negative energy balance than middle aged grown cows and the older cows might have more chance to get subclinical uterine infection resulting in lower conception rate.

CONCLUSION

Among different factors, cow (age, parity, milk yield) and insemination (postpartum insemination interval and interval between oestrus and AI) associated factors mostly affect the conception rate of zebu cows. From the results of this study it is recommended that balanced feeding and insemination within 8-12 h after the onset of standing oestrus are the two crucial factors for improvement of reproductive potentialities (conception rate) of non-descript zebu cows. Moreover, high yielding zebu cows of 4-6 years age is the best choice of selection for getting the better reproductive performance from non-descript indigenous zebu cows. However, there is still need of more research for genetic improvement of non-descript zebu cows in order to make smallholder dairy farming more profitable at the subsistence farming conditions of Bangladesh.

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