**Factors Affecting Conception Rates in Holstein Friesian Crossbreed Cattle in Uttarakhand**

**ABSTRACT**

The objective of the study was to identify the factors affecting variation in conception rate of Holstein Friesian crossbreed dairy cattle inseminated using frozen semen under field conditions. A total of 24,629 insemination records pertaining to 19,323 animals were inseminated artificially at BAIF’s field Livestock Development Centers during the period of January 2022 to September 2024 in 11 districts. Logistic regression analysis was used to compute the odds ratio and probability of conception rate. Records were classified according to districts, lactation order, year of insemination & season of insemination. Districts, lactation order, year of insemination and season of insemination showed significant variation. The overall conception rate was 40.16%. Conception rate of Pauri Garhwal district showed the highest conception rate of 48.27% than other districts under study. Conception rate of heifers was lower than that of other parities with the probability of 0.42. Highest conception rate was found in animals with fifth and above parity with probability 0.50. There was a marginal difference between second to fifth parity. In the season of insemination, the highest conception rate was observed in the winter season (42.06%) while the lowest was in the rainy season 40.45%. Highest conception rate (42.85%) was observed during the year 2023, while the lowest (38.06 %) was in the year 2024. It could be inferred that the factors like districts, lactation order, season of insemination and year of insemination should be considered while evaluating the conception rate.

**Key words**: Artificial insemination, Conception rate, Logistic regression, Odds ratio

**INTRODUCTION**

The fertility of farm animals is primarily influenced by a combination of genetic potential and environmental factors, including nutrition, health, and overall management practices employed by farmers. The percentage of pregnancy rate is widely recognized as a key indicator for evaluating fertility performance. A low conception rate can lead to undesirable outcomes such as delayed age at first calving, prolonged service periods, and extended calving intervals, ultimately reducing the animal's overall lifetime productivity. These issues often stem from factors like failure to exhibit heat, reproductive disorders, or the need for multiple services per conception. The low heritability of fertility traits indicates a significant impact of environmental and management factors, highlighting the potential for improvement through better on-farm management practices. Existing research on the relationship between factors such as animal breed, season of artificial insemination (AI), sire selection, lactation order, age at the time of AI, and AI sequence with pregnancy outcomes is limited in its ability to fully explain their influence on fertility strategies at the village level. This study aims to explore these factors and their impact on conception rates as a measure of fertility in dairy animals under field conditions in Uttarakhand, providing insights that could help in developing more effective fertility management practices at the grassroots level

**MATERIAL AND METHODS**

The data consisted of 24,629 insemination records of 19,323 Holstein Friesian crossbreed dairy cattle that were inseminated artificially at BAIF’s field Livestock Development Centers which provide doorstep AI service at villages. Artificial insemination requests were received via mobile phones, and the inseminations were carried out at the farmers' doorsteps using frozen semen. Cows that did not return to estrus within 60 to 70 days post-insemination were examined for pregnancy through rectal palpation. The pregnancy rate was determined using the formula recommended by Qureshi et al. (2008). The period covered was from January 2022 to September 2024. The available data were classified on the basis of districts, lactation order, year of insemination and season of insemination. The lactation sequence ranged from heifers, first to fifth and above. Conception rate: Conception rates (CR) were estimated from the proportion of pregnancies confirmed by the rectal palpation of the genital tract between 90 to 120 days of post-insemination among the total number of cattle inseminated artificially with frozen semen in a specified period. The conception rate was estimated by using the following formula:

Conception rate (CR) = No. of cattle pregnant/No. of cattle inseminated \*100

Insemination dates were recorded using the mobile device and stored in the server. For each cattle, the conception rate (CR) was defined as pregnant or not. Statistical analysis: Conception is a binary trait having only one of the two possibilities namely, success or failure. The most commonly used multiple analysis technique poses difficulty when the dependent variable has only two outcomes viz. event occurring or not occurring. In such a dataset, the assumption of normal distribution and equality of variances are violated. However, logistic regression model is found to be a better choice (Dyke and Patterson 1952, Ron et al. 1984, Hosmer and Lemeshow 1989) and hence adopted in the present studies. Thirunavukkarasu and Kathiravan (2006), Shamsuddin et al. (2013), Suresh Kumar and Pasupathy (2015) have used a binary logistic regression model for predicting the probability of conception rate in artificially inseminated bovines through fitted using various animal and management factors. To investigate if differences in conception rate existed between different sub classes of independent variables, a binary logistic regression model was constructed with conception rate as the dependent variable and the independent variables of interest were category of district, year of insemination, season of insemination and lactation order of cattle. The logistic regression model transforms the odds using the natural logarithm and relates it to explanatory variables through a linear equation. In the case of multiple logistic regression, multiple continuous or categorical independent variables can be integrated into the model, allowing for the simultaneous assessment of their effects on the binary outcome. To evaluate the model’s goodness-of-fit, the Akaike Information Criterion (AIC) is commonly employed (Manoj et al., 2015). The analysis was conducted using R statistical software, version 4.2.2.

**RESULTS AND DISCUSSION**

The results of analysis of conception rate using multivariate logistic regression model is presented in Table 1. In the present study, the overall conception rate in HF crossbreed cattle was observed to be 40.16%. Potdar et.al. (2020) observed 47.33±0.32% conception rate in Holstein Friesian Crossbreed Cattle in Maharashtra State. Effect of district: The conception rates were significantly different between different districts. The probability of getting the highest animals pregnant was noticed at Pauri Garhwal district 48.27% while lowest in Pithoragarh 30.05%. The reports of Bhagat et al.(2019) and Bansal et al. (2019) supported the present findings however, Pandey et al. (2016) reported non-significant effect of districts on pregnancy rate under Jharkhand state conditions. The individual farmers’ management and agro-climatic conditions of the respective district might be attributed to the significant differences in pregnancy rate of animals. District-wise detail conception rate is presented in Table 1.

**Table 1. Multivariate Logistic Regression Model for Conception Rate**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Means** | **No. of observations** | **Odds ratio** | **Relative probability [1]** | **Estimated conception rate [2] percent** |
| **District\*\*\*** | | | | | |
| Almora | 40.57% | 557 | 1 | 0.5 | 40.57% |
| Bageshwar | 43.48% | 253 | 1.09 | 0.52 | 42.28% |
| Chamoli | 49.40% | 332 | 1.34 | 0.57 | 46.44% |
| Champawat | 50.21% | 1948 | 1.43 | 0.59 | 47.77% |
| Dehradun | 45.67% | 4132 | 1.17 | 0.54 | 43.72% |
| Haridwar | 37.78% | 5019 | 0.99 | 0.50 | 40.46% |
| Nainital | 42.02% | 6778 | 1.07 | 0.52 | 41.97% |
| Pauri Garhwal | 49.49% | 120 | 1.47 | 0.59 | **48.27%** |
| Pithoragarh | 29.84% | 124 | 0.59 | 0.37 | 30.05% |
| Udham Singh Nagar | 31.58% | 5221 | 0.68 | 0.40 | 32.74% |
| Uttarkashi | 31.93% | 166 | 0.64 | 0.39 | 31.60% |
| **Parity/lactation Order \*\*\*** | | | | | |
| Heifer | 36.56% | 6114 | 0.74 | 0.42 | 39.64% |
| One | 38.85% | 3318 | 0.81 | 0.45 | 41.68% |
| Two | 40.73% | 6283 | 0.87 | 0.47 | 43.50% |
| Three | 41.87% | 5747 | 0.90 | 0.47 | 44.16% |
| Four | 43.00% | 2242 | 0.92 | 0.48 | 44.74% |
| Above Five | 46.67% | 1005 | 1.00 | 0.50 | **46.67%** |
| **Year of Insemination\*\*\*** | | | | | |
| 2022 | 41.57% | 6127 | 1.00 | 0.50 | 41.57% |
| 2023 | 41.86% | 13291 | 1.06 | 0.52 | **42.85%** |
| 2024 | 34.25% | 5291 | 0.84 | 0.46 | 38.06% |
| **Season of AI\*** | | | | | |
| Rainy | 40.45% | 8762 | 1.00 | 0.50 | 40.45% |
| Summer | 38.62% | 7172 | 1.02 | 0.51 | 40.85% |
| Winter | 41.12% | 8775 | 1.08 | 0.52 | **42.06%** |

Significance codes: 0 ‘\*\*\*’, 0.001 ‘\*\*’, 0.01, NS, nonsignificant (probability <0.05). 1 -The figure of 0.5 under relative probability indicates the reference figure for comparison with others as chosen by the Logit Regression Analysis method. The figures are an odd ratio of Success (or Failure)/ Number of events, viz. Conceived (or Not Conceived)/ Number of AI. 2 - Estimated conception rates are computed after substituting actual figure (LS mean) in place of First reference values, converting the rest of the odds ratios accordingly and multiplying by 100.

**YEAR OF AI**

In the present investigation, conception rate noticed to be significantly reduced from 41.57 % in the year 2022 to 38.06 % in the year 2024. Seasonal variation of environment, nutrition, and management alters estrus activity and duration of estrus. Conception rates reduce under the stress of heat and cold.

**SEASON OF AI**

It was revealed that the distribution of percent inseminations performed was 35% in rainy season, 29 % in summer, and 36% during winter. Bansal et al. (2019) recorded maximum AI in summer (34.96%) season compared with rainy (34.85%) and winter season (30.19%). Significantly higher pregnancies were recorded in the winter season (42.06%), followed by summer season (40.85%) and (40.45%) in the rainy season. Shindey et al. (2014), Pandey et al. (2016) and Potdar et al. (2016) reported that animals inseminated during the summer season had higher pregnancy rates. However, Bhagat and Gokhale (2013, 2016) and Bansal et al. (2019) reported higher pregnancies in the winter season. Higher pregnancies in the summer season might be attributed to a spill-over effect of the better effect of the winter season on overall animal health.

**LACTATION ORDER**

Animal lactation order significantly affected pregnancy rate (Table 1). Shindey et al. (2014), Bhagat and Gokhale (2016), Potdar et al. (2016) and Bansal et al. (2019) also recorded similar results, however, Bhagat and Gokhale (2013) and Pandey et al. (2016) recorded non-significant effect of parity on pregnancy rate. Highest conception rate was observed in animals with fifth and more parity, 46.67% while the lowest conception rate was observed in heifers, 39.64%. Gunasekaran et al. (2008), Razi et al. (2010), Bhagat and Gokhale (2016), Pandey et al. (2016) and Bansal et al. (2019) also noticed lowest pregnancy rate in heifers.

**CONCLUSION**

The study indicated that conception rate significantly affected due to district, insemination year,

season of insemination and lactation order of animal . These factors need to be emphasized for

having better pregnancy in AI bred cattle under Uttarakhand field conditions.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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