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Research Article

Impact of Conception in Estrus Synchronized Bovines – A Binary Logistics Regression Analysis

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ABSTRACT

This study was conducted to analyze the impact of conception in estrus synchronized bovines. Therefore hundred estrus synchronized and fifty non-estrus synchronized bovines were selected at random sampling method and considered for the study. The logistic regression analysis employed to estimate the probability of a particular beneficiary bovines not being able to conceive due to estrus synchronization. The result of logistic regression revealed that relationship of conception rate with discharge, average milk yield and estrus detection before synchronization were significant. Insignificant variables such as breed, postpartum interval, age at first calving, average calving interval, lactation length and abortion were indicated partial contribution to the model. Normally discharging bovines showed high conception rate where as average milk yield and estrus detection before synchronization decreased the conception rate.

Key words: *Bovine, Oestrus syncronization, Conception Rate, Binary logistic regression analysis.*

INTRODUCTION

The socio-economic development of rural people in India largely depends on livestock especially bovines. The productivity and reproductive efficiency of bovines have a major influence on economy of dairy farmers. Fertility controlled by various genetics and environmental factors of animals. Synchronization of estrus has been helpful in solving problems of infertility of bovines. Estrus synchronization procedure is highly useful in repeat breeders, infertile animals or unproductive animals to bring them back to milking. Also, this technique can overcome the possible errors in heat detection, missing heat and untimely insemination. Ultimately, this is expected to enhance the economic returns to the dairy farmers. Moreover, possible advantage of estrus synchronization is to improve reproductive performance of heifers which were not showing a consistent estrus sign. Thus, this study was undertaken to estimate the impact of conception in estrus synchronized bovines, based on various animal and environmental factors which are believed to have a say on the conception rates achieved.

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MATERIAL AND METHODS

To achieve the object of the study, among 20 districts in Tamil Nadu in which the NADP scheme on "Genetic Upgradation of Cattle and Buffaloes in Tamil Nadu: Adoption of Oestrus Synchronization Technique to Improve Productive and Reproductive Potential" was implemented in the first phase. Salem and Tiruchirapalli districts were randomly selected in the first stage of multistage random sampling. In the second stage, five villages from each of the chosen two districts were randomly selected. In third stage of sampling, from each of the five selected villages, list of the beneficiaries of the scheme was prepared. From this list, ten beneficiaries were selected in each of the villages by simple random sampling. Likewise, five non-beneficiaries were selected in each of the villages randomly, leading to a total of 100 beneficiaries and 50 non-beneficiaries which found the sample for the study. The data collected were analyzed and result reported.

Binary Logistic Regression Analysis

In explaining a dichotomous dependent variable conception (Y_i), where "one" represents conceived animals and "zero" represents not conceived animals. If there is non- linear relationship between dependent and independent variables, logistic function is used to estimate the association between binary, endogenous variable, Y, and the independent variables, Xs. Given the non-linearity of the probabilistic association between conception in oestrus synchronization program and the classical linear regression model, ordinary least squares, is not appropriate for its estimation. Hence, the following mathematical form of the model was used in this study.

$$\ln\left(p_i/(1-p_i)\right) = \beta_o + \sum_{j=1}^{k} \beta_j X_{ij}$$

Where, p_i is the probability of the i^{th} beneficiary conceived in oestrus synchronization program and X_k is the k^{th} explanatory variable. The dependent variable, $\ln (p_i / (1- p_i))$, in the equation is the log-odds ratio in favour of conception as beneficiary in oestrus synchronization program[3].

The definitions of the most important variables expected to influence in the conception of bovines in Oestrus synchronization program are given in the following:

X_1	=	Breed of the animal (1 = Cross breeds; 0 = Otherwise)
X_2	=	Postpartum interval (days)
X_3	=	Age at first calving (yrs)
X_4	=	Average calving interval (months)
X_5	=	Average milk yield (litres/day)
X_6	=	Lactation length (day)
X_7	=	Type of vaginal mucus discharge (0 = Abnormal; 1 = Normal)
X_8	=	Abortion (1 = Abort; 0 = No Abortion)
X_9	=	Estrus Detection (0 = Good; 1 = Poor)

Following these, the following binary logistic regression model was postulated as, used by Panda[3].

$$\ln (p_i / (1- p_i)) = \beta_o + \beta_1X_1+ \beta_2 X_2+ \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 +\beta_8X8+\beta_9X_9$$

where,

p_i	=	Probability of conception
$(1- p_i)$	=	Probability of not conception
β_0	=	Constant term
β_i's	=	Regression coefficients
X_i	=	Determinant factors

The binary logistic regression analysis was carried out using the software – SPSS regression analysis.

RESULTS AND DISCUSSION

The results of the logistic regression function model fitted are presented in table 1. As it could be seen from the table, Wald statistic obtained for the independent variables indicated that the coefficients for the variables breed, postpartum interval, age at first calving, average calving interval, average milk yield, lactation length, discharge, abortion and estrus detection were all significantly different from zero to one degree of freedom. The table also presents the estimated coefficients of independent variables incorporated in the logistic model along with their standard errors and their exponential values.

The positive value of coefficient obtained for discharge (1 = normal) indicated that as this variable increase in value by units, the likelihood of conception increased by 6.031 units. The negative coefficients in case of average milk yield and estrus detection (before synchronization) (1 = poor) indicated that the likelihood of conception decreased by 1.077 units and 6.368 units, respectively. The statistically insignificant variables such as breed, postpartum interval, age at first calving, average calving interval, lactation length and abortion indicated that these variables had got only smaller and partial contribution to the model.

The logit equation indicated that the logistic coefficients can be interpreted as the change in the log odds associated with one unit change in the independent variables. The logit model estimated in terms of the log of the odds, is:

$$\text{Log}\left[\frac{\text{Prob(conceived)}}{\text{Prob(not conceived)}}\right] = \text{Log}\left[\frac{P_i}{1-P_i}\right]$$

$$= 1.412 - 0.179X_1 + 0.042\ X_2 + 0.839\ X_3 + 0.135\ X_4 - 1.077\ X_5** + 0.007\ X_6 + 6.031\ X_7* + 2.944\ X_8 - 6.368\ X_9**$$

That is, when cattle is synchronized with normal mucus discharge, with the values of other independent variables remaining the same, the log odds of the cattle getting conceived increased by 6.031 units. Similarly, when other variables such as postpartum interval, age at first calving, average calving interval, lactation length and abortion increased by one unit, *Ceteris paribus*, the log odds of the female bovines to get conceived increased by 0.042, 0.839, 0.135, 0.007 and 2.944 units, respectively. However, when the average milk yield and estrus detection decreased by one unit, the log odds of the animal getting conceived decreased by 1.077 and 6.368 units, respectively.

Table 1: Parameter estimates of logistic regression model

Dependent variable	Conception (1 = Conceived, 0 = Non-Conceived)				
Variable	**Coefficient estimate**	**Std. Error**	**Wald Statistic**	**p value**	**Exp(B)**
Breed	-0.179	1.172	0.023	0.878	0.836
Postpartum interval (months)	0.042	0.068	0.388	0.534	1.043
Age at first calving (yrs)	0.839	0.677	1.536	0.215	2.313
Average calving interval (months)	0.135	0.195	0.480	0.488	1.145
Average milk yield (litres)	-1.077	0.324	11.043**	0.001	0.341
Lactation length (days)	0.007	0.009	0.629	0.428	1.007
Discharge	6.031	3.152	3.661*	0.049	416.064
Abortion	2.944	5.656	0.271	0.603	18.993
Estrus detection (before synchronization)	-6.368	1.869	11.606**	0.001	0.002
Constant	1.412	5.885	0.058	0.810	4.105

Note: *Significant at five per cent level of probability, **Significant at one per cent level of probability.
(Degree of freedom for each variable is 1)

Similar attempt was also made by Tirunavukkarasu and Kathiravan[6] to develop a logistic regression model for predicting the probability of conception in artificially inseminated bovines based on species, breed, and stage of lactation, average milk yield in litres, reproductive disorders and month of insemination. They obtained for reproductive disorders (0 = absent) indicated that as this variable increases in value, the likelihood of conception increased by 2.5638 units and value of average milk yield in litres, decreased the likelihood of conception by 0.1973 units. First service conception was affected by the body condition score followed by heat signs and months of the year when AI was performed in the cows as demonstrated by greater ($p < 0.001–0.05$) regression coefficients and odds ratios reported by Siddiqui *et al.*[5].

Table 2: Goodness of fit

Particulars	Value
Chi – square	80.719**
- 2Log likelihood	27.136
Cox & Snell R Square	0.554
Nagelkerke R Square	0.839

**Significant at one per cent level of probability

If a model fits perfectly, the likelihood is zero. For the fitted logistic regression model, the value of -2 Log Likelihood was 27.136. The values of Cox and Snell R square and Nagelkerke R square estimated were 0.554 and 0.839, respectively, which indicated that explained model was a good fit.

CONCLUSION

This study was to undertaken to analyze the impact of conception rate in oesrus synfhronized bovines. Thus, the result of the study revealed oestrus synchronization increased the conception rate by decrease in the number of inseminations per conception thereby it reduce the calving interval. Oestrus synchronization indirectly increased the estrus detection efficiency in breeding bovines and thereby identifying the missing heat or silent heat.

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