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# Role of Technology in Reducing Losses in Dairy Animals Due to Delayed Conception: A Case of *"ICAR-IVRI Crystoscope"*

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## ABSTRACT

**Background:** In field situations often failure to breed timely leads to delay in conception causing significant losses to the dairy farmers. ICAR-IVRI, Izatnagar has developed '*ICAR-IVRI Crystoscope*' for detection of right-time for breeding.In Indian context, literature on reproduction economics, documenting the costs delayed conception, is scant. Further, in spite of the potential inherent in the above-mentioned technology, no systematic attempt has been made to ascertain its economic impact. The present study assessed the economic impact of use of '*ICAR-IVRI Crystoscope*' in terms of losses avoided in dairy animals.

**Methods:** The study is based on field survey covering 628 cattle from sample 117 households, selected from Jammu region of Jammu and Kashmir state of India. The approach to identifying incidence of delayed conception comprised interview with Para-veterinarians/Inseminators by visiting each case of delayed conception with them; crosschecking with the records kept by the Para-veterinarians/Inseminators and validation by holding focused group discussions with Government Veterinary Officers, Para-veterinarians, inseminators and the farmers. Primary data were collected through personal interview of head of sample households with the help of a well-structured, comprehensive and pretested interview schedule.

**Result:** Overall incidence of delayed conception, due to failure to detect optimum breeding time, ranged between 22-29%. Average number of services required per conception and days delayed in conception were less in treatment villages than in control ones. The study revealed that one extra day delayed in conception increases the total loss per animal due to delayed conception by INR 138.0, while use of '*ICAR-IVRI Crystoscope*', reduces loss due to delayed conception per animal by INR 2965.55. The study thus provides definite indications that use of the technology has significant impact on reduction in total loss due to delayed conception on account of failure to detect optimum breeding time.

**Key words:** Delayed conception, Economic losses, Optimum breeding time, Reproduction inefficiency.

## INTRODUCTION

Major indicators that characterize bovine reproductive inefficiency are higher age at first calving, longer calving interval, late reproductive maturity and increased dry period, leading to decline in farm income (calf crop reduction and milk yield reduction) and avoidable expenditures (*viz*. extra breeding, feeding, treatment and labour costs). Increasing trends in decline in conception rates and increase in calving interval over last decades have been reported worldwide (Royal *et al*., 2000; Lucy, 2001; Hare *et al*., 2006). In field situations often failure to inseminate or breed timely leads to delay in conception and missing of estrous cycle(s) causing significant losses to the dairy farmers. Proper detection of estrous is necessary for planned insemination programs for dairy cows.

ICAR-Indian Veterinary Research Institute, Izatnagar has developed a cost effective and a simplified technology *'ICAR-IVRI Crystoscope'* for ascertaining optimum time of breeding the animals for getting maximum conception rate. About 62.5 per cent success rate in conception has been reported upon use of this technology as against 35.29 per cent success rate obtained from insemination practices, with non-use of the same. The technology is cheaper, durable, can be used on large number of animals and does not require special skills for its use.

In the Indian context, literature on reproduction economics, documenting the costs of reproductive inefficiencies, like delayed conception, is scant. Further, in spite of the potential inherent in the above-mentioned technology, no systematic attempt has been made to ascertain its economic impact. The present study was carried out with the specific objectives of evaluating the economic losses caused due to delayed conception in dairy animals and to estimate the benefits of '*ICAR-IVRI crystoscope*' technology.

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## MATERIALS AND METHODS

### Study area

The study was conducted in Jammu and Kashmir state of India. In the Jammu region of the state, use of 'ICAR-IVRI Crystoscope' is common and many Government Veterinary

Officers and Para-veterinarians have been using the same technology for the last several years. Since the main aim of this study was to ascertain the impact of '*ICAR-IVRI Crystoscope*' at farmers' field level, availability of relevant data regarding the use of this technology was crucial. As such, Jammu region was selected for this study.

**Sampling design**

Kishtwar district was selected from the Jammu province on account of regular use of '*ICAR-IVRI Crystoscope*' in some blocks of the district by the Veterinarians and Para-veterinarians which ensured availability of relevant and reliable data. Two blocks were selected from the district based upon the sustained use or non-use of the technology. Block 1 was Kisthwar where 'ICAR-IVRI Crystoscope' was used on sustained basis. Block 2 was Inderwal where 'ICAR-IVRI Crystoscope' had never been used. Two villages were selected from each of these two blocks, randomly. From each selected village, 30 households-having at least one milch animal or heifer-were selected randomly. Table 1 summarizes the distribution of sample households across blocks and villages.

**Data**

The study was based upon primary data which were collected through personal interview of head of sample households. A pre-tested comprehensive interview schedule was developed for the purpose comprising questions for eliciting data from respondents on demographic particulars of sample respondents, technical characteristics of dairy enterprise, reproductive parameters and costs and returns structure from dairy enterprise.

**Identification of animals with incidence of delayed conception**

The aim of the study was to calculate the economic losses due to delayed conception in dairy animals. Delayed conception is defined as an interval of more than 90 days postpartum before a cow or buffalo becomes pregnant again (Kim and Kang, 2006). First heat sign after the voluntary waiting period was noted along with month in which first service was done. Month of conception was then noted after services per conception having taken place after every 21 days. In case of heifers, age of maturity was considered as 30 months. Numbers of days delayed in heifers was counted from the age of maturity. The age of the heifer at the time of first heat sign was noted and then the month in which first service was done and then month of conception was noted. In this way, the number of days delayed was counted for in heifers.

The approach adopted in this process was to interview Para-veterinarians/Inseminators in the study area by using structured check list to obtain their perception on the possible reasons for delayed conception with special focus on identifying those cases of delayed conception which were due to failure to detect optimum breeding time in animals. The reference period for this study was the last 12 months period previous to the date of the survey. Important indicator in ascertaining the cause of delayed conception as failure to detect optimum breeding time was to ask the para-veterinarians/inseminators about cases where the animals showed symptoms of early/late estrus at the time of insemination. Each case of delayed conception (as observed during the reference period of this study) was visited along with the concerned para-veterinarian/inseminator who had inseminated the animal. This was crosschecked with the records kept by the Para-veterinarians/Inseminators. The records contained details of the time at which they were informed about the animal coming to heat and the actual time of insemination. This was further validated by holding focused group discussions with Government Veterinary Officers, Para-veterinarians, inseminators and the farmers.

**Components of losses due to delayed conception**

The total loss due to delayed conception was represented as the summation of different loss components:

$$\text{Total loss} = A + B + C + D + E$$

**Extra feed cost (A)**

$$A = DD \times F$$

Where

A = Extra feed cost due to delayed conception.

DD = Number of days delayed from the end of voluntary waiting period (in case of milch animals) and from the date of achieving maturity (in case of heifers).

F = Per day feeding cost of the animal.

**Extra labor cost per animal (B)**

$$B = DD \times L$$

Where

B = Extra labour cost due to delayed conception.

L = Per day labour cost.

**Extra treatment cost(C)**

$$C = (V + M) \times N_v$$

Where

C = Extra treatment due to delayed conception;

V = Fees charged by veterinarian/para-veterinarian per visit.

M = Expenditures on medicines.

$N_v$ = Number of visits made by veterinarian/para-veterinarian due to incidence of delayed conception.

**Extra breeding cost per animal (D)**

$$D = BC \times PS$$

Where

D = Extra breeding costs per animal.

BC = Number of services per conception.

PS = Costs of breeding (AI) per service.

**Value of milk loss (E)**

The yield differential was arrived at by comparing animals which have experienced delayed conception with those animals which have not (Ali, 2011).

$$E = [LL_{nd} \times (M \times Y_{nd} + MnY_{nd})/2] - [LL_{d} \times (M \times Y_{d} + MnY_{d})/2]$$

Where

E = Milk yield loss per animal due to delayed conception.

nd = Animals with no incidence of delayed conception.

d = Animals with incidence of delayed conception.

LL = Average lactation length.

M×Y and MnY = Average maximum and minimum milk yields, respectively.

**Projection of total losses due to delayed conception at the state level**

Following equation was used to project the total loss due to delayed conception at the state level:

$$L_{DC} = \sum_{1}^{i} \sum_{1}^{n} [dc_i \times P_i \times C_n]$$

Where

$L_{DC}$ = Total loss due to delayed conception in the state.

i = The animal category, *i.e.* crossbred animals (milch and heifers) and indigenous animals (milch and heifers).

n = Different components of losses due to delayed conception.

$dc_i$ = The incidence of delayed animals in i$^{th}$ category of animals.

$P_i$ = The population of animals in the i$^{th}$ category at risk.

C = The cost of n$^{th}$ component.

**Estimation of potential losses avoided due to use of 'ICAR-IVRI Crystoscope' technology**

The animals which exhibited delayed conception on account of failure to detect optimum breeding time in villages without '*ICAR-IVRI Crystoscope*' intervention served as the control cases. The animals which exhibited delayed conception on account of failure to detect optimum breeding time in villages with '*ICAR-IVRI Crystoscope*' intervention served as the treatment cases. The incidence of delayed conception due to failure to detect optimum breeding time and number of days delayed in control animals were compared with the same in treatment animals. The total loss at the state level due to delayed conception on account of failure to detect optimum breeding time was estimated using the two incidence rates, *viz*. incidence rate in control villages and incidence rates in treatment villages. The difference in the total losses as obtained using these two incidence rates was the savings from use of '*ICAR-IVRI Crystoscope*' in the state of Jammu and Kashmir.

**Factors influencing per animal loss due to delayed conception**

A multiple regression equation was fitted to ascertain the influence ofrelevant factors on per animal loss due to delayed conception:

$$Y_i = \alpha + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 X_1 + \mu_i$$

Where,

$Y_i$ = Loss due to delayed conception in individual animal i;

D = A dummy variable representing the variable crossbred animal (D= 1 if the animal is crossbred and $D_1$= 0 the animal is indigenous).

$D_2$ = A dummy variable representing the variable 'milch animal' ($D_2$= 1 in case of milch animal and $D_2$= 0 if the animal is a heifer).

$D_3$ = A dummy variable representing the variable 'Use of ICAR-IVRI Crystoscope' ($D_3$= 1 if 'ICAR-IVRI Crystoscope' was used to detect optimum breeding time and $D_3$= 0, otherwise).

$X_1$ = The number of days delayed for individual animal.

## RESULTS AND DISCUSSION

Table 2 elicits the distribution of dairy animals surveyed in the study across breeds (crossbred or indigenous) and categories (milch or heifers). A total of 628 animals were covered in the study distributed across the two selected blocks.

**Economic losses due to delayed conception**

The per annum total losses were projected for the state of Jammu and Kashmir. When, the losses due to delayed conception were computed based upon observations in control villages, losses due to failure to detect optimum breeding time accounted for 43.50%, 44%, 31% and 56%, respectively, for crossbred milch animals and heifers and indigenous milch animals and heifers (Table 3). The proportions of delayed conception losses accounted for by failure to detect optimum breeding time-based upon observations in treatment villages in crossbred milch animals and heifers and indigenous milch animals and heifers were 40.50 per cent, 26 per cent, 17 per cent and 59 per cent, respectively. Comparison of proportions of losses due to delayed conception on account of failure to detect optimum breeding time-as per the two sets of incidence rates - reveals that the share of delayed conception losses due to failure to detect optimum time of breeding comes down when the total losses at the state level are projected using the

**Table 1:** Distribution of sample households across blocks/villages.

| Block | Village | No. of HH's | No. of animals | | | |
|---|---|---|---|---|---|---|
| | | | CB (milch) | CB (Heifers) | Ind. (milch) | Ind. (Heifers) |
| Block 1- Inderwal(without crystoscope intervention) | Chatroo | 30 | 59 | 53 | 26 | 13 |
| | Sigdee | 30 | 67 | 50 | 28 | 15 |
| Block 2- Kishtwar(with crystoscope invention) | Tund | 30 | 61 | 58 | 37 | 22 |
| | Munshigwarh | 27 | 43 | 46 | 33 | 17 |

**Table 2:** Distribution of sample animals across different categories.

| Categories | Block 1 | | Block 2 | |
|---|---|---|---|---|
| | CB | Ind. | CB | Ind. |
| **Milch** | | | | |
| In-milk | 85 | 38 | 68 | 48 |
| Dry | 41 | 18 | 36 | 22 |
| Total Milch | 126 | 56 | 104 | 70 |
| | (55.02) | (65.88) | (49.06) | (68.63) |
| **Heifers** | | | | 32 |
| >2 yrs. | 65 | 18 | 68 | 21 |
| <2 yrs. | 38 | 11 | 40 | 11 |
| Total Heifers | 103 | 29 | 108 | 32 |
| | (44.98) | (34.12) | (50.94) | (31.37) |
| Total animals | 229 | 85 | 212 | 102 |

incidence rate of failure to detect optimum breeding time as observed in treatment villages.

**Reproductive efficiency parameters**

The overall incidence of delayed conception in sampled animals ranged between 63-70% (Table 4). The overall incidence of delayed conception, due to failure to detect optimum breeding time, ranged between 22-29%. There were no significant differences in the incidences of delayed conception between the groups of villages with and without the technology intervention. However, the average number of days delayed from the voluntary waiting period (in case of milch animals) or the time of attaining reproductive maturity (in case of heifers) were lesser in treatment villages as compared to the control villages for all breed/categories of animals. As such, the number of services per conception (indicator of reproductive efficiency) was relatively lesser in villages with the intervention of the technology.

**Avoided losses due to use of '*ICAR-IVRI Crystoscope*'**

The total loss (INR 304 crores) in the state, based upon incidence of delayed conception as observed in villages where the technology has been used, was lesser than the same (INR 503 crores) which was obtained on the basis of incidence rate as observed in villages without the technology intervention. The difference in these two estimates of the state-level losses (INR 199 crores) provided an estimate of the potential avoided losses due to delayed conception on account of failure to detect optimum breeding time which can be accrued to the use of '*ICAR-IVRI Crystoscope*' (Table 5). This provides definite indications that '*ICAR-IVRI Cystoscope*', being a cost effective and a simple technological tool -for ascertaining optimum time of breeding- improves the reproductive efficiency of the animals and hence of is of great economic significance.

**Factors influencing per animal losses due to delayed conception**

Table 6 presents the results of the regression analysis. The $R^2$ value of the model was 69.2 per cent, while the F-value was significant at 1 per cent level of significant. The results of the regression model revealed that all the independent

**Table 3:** Losses due to delayed conception.

| Variable | CB (Milch) | CB (Heifer) | Ind. (Milch) | Ind. (Heifer) |
|---|---|---|---|---|
| **Based upon incidence rate as observed in villages without 'ICAR-IVRI Crystoscope' intervention** | | | | |
| Per animal loss (INR) due to delayed conception | 27936.12 | 10424.90 | 15823.30 | 5480.57 |
| Per animal loss (INR) due to delayed conception (on account of failure to detect optimum breeding time) | 30366.00 | 9811.00 | 15590.00 | 6126.70 |
| Total loss due to delayed conception (INR in crores) | 1040.40 | 110.86 | 4.27 | 0.32 |
| Total loss due to delayed conception (on account of failure to detect optimum breeding time) (INR in crores) | 453.03 | 48.51 | 1.34 | 0.18 |
| % share of losses due to delayed conception (on account of failure to detect optimum breeding time) to total loss due to delayed conception | 43.54 | 43.76 | 31.38 | 56.25 |
| **Based upon incidence rate as observed in villages with 'ICAR-IVRI Crystoscope' intervention** | | | | |
| Per animal loss (INR) due to delayed conception | 19695.95 | 5553.17 | 10691.77 | 5476.41 |
| Per animal loss (INR) due to delayed conception (on account of failure to detect optimum breeding time) | 21348.74 | 5871.55 | 10591.70 | 7015.86 |
| Total loss due to delayed conception (INR in crores) | 710.67 | 58.93 | 2.86 | 0.32 |
| Total loss due to delayed conception (on account of failure to detect optimum breeding time) (INR in crores) | 287.83 | 15.23 | 0.48 | 0.19 |
| % share of losses due to delayed conception (on account of failure to detect optimum breeding time) to total loss due to delayed conception | 40.50 | 25.84 | 16.78 | 59.38 |

**Table 4:** Parameters regarding delayed conception.

| Particulars | Block 1 (Villages without crystoscope intervention) | | | | Block 2 (Villages with crystoscope intervention) | | | |
|---|---|---|---|---|---|---|---|---|
| | CB (Milch) | CB Ind. (Heifers) | Ind. (Milch) | Ind. (Heifers) | CB (Milch) | CB (Heifers) | Ind. (Milch) | Ind. (Heifers) |
| Incidence of delayed conception | 67.4 | 63.10 | 70.3 | 64.28 | 65.3 | 62.97 | 68.57 | 65.62 |
| Incidence of delayed conception (due to failure to detect optimum time of breeding) | 27.00 | 29.34 | 22.44 | 33.34 | 24.40 | 28.80 | 21.10 | 30.30 |
| Average days delayed | 56.16 | 58.18 | 66.69 | 61.59 | 36.41 | 36.65 | 38.51 | 36.28 |
| Average no. of service per conception | 3.6 | 5.2 | 4.2 | 4.7 | 2.5 | 3.2 | 3.1 | 3.4 |

**Table 5:** Economic losses avoided (Rs. in crores) due to crystoscope intervention in Jammu and Kashmir.

| Variable | CB (Milch) | CB (Heifer) | Ind. (Milch) | Ind. (Heifer) |
|---|---|---|---|---|
| Total loss due to delayed conception (on account of failure to detect optimum breeding time) based on incidence rate without 'ICAR-IVRI Crystoscope' intervention (INR in crores) | 453.03 | 48.51 | 1.34 | 0.18 |
| Total loss due to delayed conception (on account of failure to detect optimum breeding time) based on incidence rate with 'ICAR-IVRI Crystoscope' intervention (INR in crores) | 287.83 | 15.23 | 0.48 | 0.19 |
| Difference in total loss (INR in crores) (4-5) | 165.20 | 33.28 | 0.86 | -0.01 |
| Total loss saved (INR in crores) | 199.33 | | | |

**Table 6:** Factors influencing per animal loss due to delayed conception (Regression results).

| Particulars | β | S.E. |
|---|---|---|
| Crossbred | 6095.19*** | 507.91 |
| Milch animal | 8557.05*** | 473.36 |
| Use of crystoscope | -2965.55*** | 492.32 |
| Days open | 138.30*** | 7.81 |
| Constant | -2351.87 | 756.73 |
| $R^2$ | 69.20 | |
| F-value | 225.92*** | |

*** Significant at 1% level of significance.

variables significantly influenced the per-animal economic losses. The signs of the coefficients of all the variables were positive, with the exception of the variable 'use of *ICAR-IVRI Crystoscope*'. The values of the regression coefficients reveal that if the animal is crossbred then the per-animal loss due to delayed conception increases by INR 6095, as compared to an indigenous animal. The animal being a milch animal results in increase in per-animal loss by INR 8557 as compared to a heifer. One extra day open due to delayed conception increases the loss by INR 138. Use of ICAR-IVRI technology in the animal for determining the optimum time of AI reduces the per-animal loss by INR 2966. The above results thus provide definite indicators that the technology has the potential to reduce the losses due to delayed conception significantly.

## CONCLUSION

The study thus addressed two important research gaps in the Indian context, regarding the economics of reproductive inefficiencies, *viz*. providing estimates of economic losses due to delayed conception in dairy animals and ascertaining the potential impact of use of '*ICAR-IVRI Crystoscope*' technology in terms of losses avoided from delayed conception (on account of failure to detect optimum time of breeding. The quantitative estimates of potential impact of the technology, thus provide definite indicators that the technology has the potential to reduce the losses due to delayed conception significantly and thus its use needs to be scaled up significantly. Results of regression analysis fitted to identify the factors significantly influencing per animal losses due to delayed conception revealed that use of '*ICAR-IVRI Crystoscope*' technology in dairy animals - for determining the optimum time of AI - reduces the per animal loss by INR 2, 966.

**Conflict of interest:** None.

## REFERENCES

Ali, Sadaf. (2011).Economic Losses Due to Delayed Conception in Dairy Animals of Small Farmers in District Gujranwala. Master's Thesis, University of Faisalabad, Pakistan.

Hare, E., Norman, H.D., Wright, J.R. (2006). Trends in calving ages and calving intervals for dairy cattle breeds in the United States. Journal of Dairy Science. 89: 365-370.

Kim, I.H. and Kang, H.G. (2006). Risk factors for delayed conception in Korean dairy herds. Journal of Veterinary Vet. Science. 7(4): 381-385.

Lucy, M.C. (2001). Reproductive Loss in High-Producing Dairy Cattle: Where Will It End? Journal of Dairy Science. 84: 1277-93.

Royal, M.D., Darwash, A.O., Flint, A.P.F., Webb, R., Woolliams, J.A. and Lamming, G.E. (2000). Declining fertility in dairy cattle: Changes in traditional and endocrine parameters of fertility. Journal of Anim. Science. 70: 487-501.