



Financial losses and cost benefit analysis of controlling anestrus in dairy animals of Punjab

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Received: 26 June 2020; Accepted: 2 August 2021

ABSTRACT

The main objective of this study was to evaluate the financial losses associated with anestrus and cost benefit analysis of various factors controlling this disease in dairy animals of Punjab region. The overall economic loss incurred by dairy farmers due to anestrus irrespective of species of animals was ₹ 24,362. The mean economic losses per animal per year was almost same in crossbred cattle (₹ 27,511.48±1,227.60) and buffaloes (₹ 27,038.69±1,128.05) and lower in indigenous cattle (₹ 18,296.95±1,317.53). When the average annual losses due to different components were estimated, the largest component was due to replacement cost followed by milk yield loss cost, future calf reduction and veterinary charges. Among different agro-climatic zones (ACZs), highest loss was observed in Central Plain Region (₹ 27,384.63±2,407.03) and the least affected zone was Flood Plain Region (₹ 19,135.6±4,326.50). While controlling anestrus at farm level through different control measures, the overall benefit cost ratio was estimated to be 5.33. The projected loss in Punjab state due to anestrus in dairy animals was estimated to be ₹ 2135.79 crore. It may be concluded that the mean economic losses per animal per year was higher in crossbred cattle and buffaloes, where the largest component was due to replacement cost followed by milk yield loss, future calf reduction and veterinary charges. In order to control economic losses due to anestrus, it is important to improve all aspects related to heat detection, and to provide appropriate preventive or therapeutic measures.

Keywords: Anestrus, Buffalo, Cattle, Cost benefit analysis, Economic loss

Good reproductive performance has an impact on entire lactation of the dairy animal including length of calving interval, milk production and breeding costs. Poor reproductive performance, on the other hand, results in financial burden to dairy farmers in terms of reduced production, anestrus, extended dry period, decreased calving percentage, less number of lactations in lifetime, less number of calves born, increased cost of management and culling of the animals (Meadows *et al.* 2005, Mulligan *et al.* 2006, Inchaisri *et al.* 2009). Reproductive infertility is not only an important factor in the involuntary culling process, it also reduces the revenue from selling of calves and the availability of replacement cows. It is estimated that about 18–40% of cattle and buffaloes were culled mainly due to infertility problems (Khan *et al.* 2009). Among the infertility issues, anestrus and repeat breeding causes most devastating losses to livestock owners in India.

Anestrus is the absence of cyclical manifestation of estrus, with the absence of palpable follicular or luteal structures or absence of physiological signs of estrus. Anestrus is more common in buffaloes than in cattle, and

the problem is more severe during summer months. Summer anestrus is mainly caused by management factors, nutritional deficiencies, animal discomfort, breeding and hormonal changes (Windig *et al.* 2005). Summer anestrus in buffaloes involves silent estrus, poor display of estrus signs and failure to detect estrus by the farmers along with limited resources of nutrition. Decrease in pregnancy rate results in increased days in milk, and hence increased management, feed, and veterinary costs for animals in the least profitable portion of lactation (Joseph and Amin 2009). In Punjab, 17–67% cattle and 31–55% buffaloes experience anestrus (Dua 2003 and Singh *et al.* 2006). Pawshe *et al.* (2011) reported an estimated loss from anestrus in cattle around ₹193.00 per cow per day, however; as such reports on economic losses are meager in buffaloes. In general, most of the farmers of the country are unaware about such losses from anestrus. Various hormonal and non-hormonal treatments have been tried for the management of anestrus in cattle and buffaloes with variable success rate depending upon the causative factors and field and farm conditions. As such no single panacea are available for the correction of anestrus condition in cattle as well as buffaloes. The objectives of the present study are to estimate the financial losses incurred by dairy farmers of Punjab due to anestrus and the cost-benefit analysis of the control measures.

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MATERIALS AND METHODS

Study area and sampling schedule: Study was carried out in all the six agro-climatic zones (ACZs) of Punjab state described by Mahi and Kingra (2013), viz. Sub-mountainous Undulating Region (Zone I), Undulating Plain Region (Zone II), Central Plain Region (Zone III), Western Plain Region (Zone IV), Western Region (Zone V) and Flood Plain Region (Zone VI). Sampling was done by multistage stratified random sampling method (Malik and Verma 2018). From each zone, two districts were taken randomly, and then from each selected district, two Tehsils were selected. From each selected Tehsil, 3 villages were taken for this study. Thus, the sampling comprised of 12 districts, 24 Tehsils and 72 villages. On the basis of a pre-survey, a list of farmers having at least 5 dairy animals, were prepared for each selected village. Thereafter, 10 livestock owners/households were randomly selected from each village. Thus, 720 livestock owners/households constituted the ultimate sampling units for the study. Out of 720 farmers, 112 reared cattle only, 472 reared buffalo only, and the remaining 136 farmers reared both cattle and buffalo. The data pertaining to various aspects of anestrus were collected from the selected dairy farmers. The respondents were interviewed for data collection using interview schedule specially prepared for the purpose. Data on current milk production, days in milk, treatment costs, animal cost, labour charges, veterinary charges, feeding costs, etc. were collected from each farmer.

Estimation of economic losses associated with anestrus syndrome: Losses associated with anestrus had both direct and indirect impact on financial returns which were underestimated and invisible to dairy farmers. The losses include veterinary expenses (treatment cost, veterinarian charges and diagnostic cost), extra labour charges, miscellaneous cost, the impact of yield loss throughout the lactation during the anestrus period, expected calf loss and replacement cost or culling cost perceived.

Economic losses from post-partum period 60–90 days were not considered in lactating animals, milk loss was estimated for whole lactation period (290 days) considering the previous study of Ribeiro *et al.* (2012) for low producers (local cow and buffalo) and high producers (crossbred cow), future calf crop expected was estimated for whole year from its market value and extra labour charges were calculated only during the veterinary intervention @ ₹40 per hour (wage rate per day @ ₹330) and extra feed cost during anestrus period wasn't taken into account but was considered in the miscellaneous charges as maintenance cost of animal. Intervention of control measures for measuring benefit cost analysis was ₹ 2500 for crossbred cattle and ₹2000 in indigenous cattle and buffaloes.

Expected milk yield reduction: Expected reduction in milk yield during the open days of anestrus was estimated based on the study conducted by Ribeiro *et al.* (2012) with the loss of 1.51 kg/cow/day of calving interval in high-producing animals. Whereas, for moderate/low producing animals of 1.11 kg of milk/cow/day of calving interval.

Average extended days open during anestrus period was assumed to 290 days excluding 60–90 days post parturient period.

$$M_L = (\mu_m - \mu_p) \times P$$

where, M_L , Average milk yield reduction per animal per lactation; μ_m , Mean milk yield of the whole lactation (liters/animal/day); μ_p , Period milk yield, is the average milk yield of the period of involuntary extended lactation being considered (liters/animal/day); and P , Prevailed average price of milk in the market (₹/litre).

Extra labour engagement:

$$E_L = \sum_{j=1}^f ((D_j - P_j) / 8) \times T \times W / n$$

where E_L , extra labour engagement cost for nursing the animal (₹); D_j , manpower engaged during affected period in j^{th} farm (hrs/day); T , average duration of handling (days); W , wage rate/day (₹); f , number of farms; n , number of affected animals.

The extra labour engaged during the veterinary interventions was equal across the species (indigenous cattle, crossbred cattle and buffaloes), as all the animals were reared under one roof. The total labor hours was divided by 8 to calculate man-days, since 8 hours of work is equivalent to one man-day.

Culling cost or Replacement cost: Replacement cost includes the number of animals culled not recovering properly from the affected condition of anestrus.

$$CR = \frac{\sum_{k=1}^n RC \times (V_a - V_r)}{N}$$

where, CR , replacement cost of animal (₹); RC , culling rate of animals in a herd; V_a , average value of animal in the market (₹); V_r , average market value of replaced animal; and N , average number of days extended due to anestrus. Similarly, for indigenous cattle and buffaloes replacement cost was calculated.

Veterinary cost:

$$T_c = \frac{\left[\sum_{j=1}^f (AI + V_c + M_c) + D \right]}{n}$$

where T_c , Total average cost of treatment (₹); AI , cost of extra AI inseminations (₹); V_c , veterinarian examination cost (₹); M_c , treatment cost/visit (₹); D , no. of veterinary intervention (number); f , number of farms; n , number of affected animals.

Future calf reduction: Future calf reduction was estimated on the basis of value of total number of days open during the anestrus period on dairy animals.

$$EFL = C_v \times CI / N$$

EFL , Expected future loss of new born calf; C_v , Average market value of calf; CI , Average calving interval of animal; N , Average of total number of days open during the anestrus.

Miscellaneous cost: It includes extra feeding cost and other maintenance charges. Extra feeding cost includes the extra feeding regime during the prolonged open days of animals after postpartum period (290 days). Average cost of feeding regime per day per animal was calculated as per the market rate. Economic cost of keeping a cow one extra day can be calculated based on the difference between the projected values of a cow in two consecutive months not conceiving.

For estimation of financial losses due to anestrus, following assumptions and simulations were incorporated to estimate the exact figures. Losses after calving period from 60 to 90 days were not incorporated for its calculation; average feed cost @ ₹ 100 per day extended period, market value of calf @ ₹ 5000; average extended days open of 290 days; extra labour utilized only during the veterinary intervention of anestrus period (@ ₹ 40 per hour).

Statistical analysis: The data were analyzed by one-way ANOVA followed post-hoc test using SPSS software (v. 20). The probability value of less than 0.05 was considered significant. Data are presented as Mean±SE.

RESULTS AND DISCUSSION

Component-wise economic losses: The present study estimated both direct and indirect losses to the dairy farmers, viz. milk yield reduction, treatment cost, extra labour

charges to nurse animal, replacement cost of culled animals, future calf reduction and miscellaneous costs (Table 1). The estimation of various financial losses due to anestrus is based on prevalence rate of anestrus (13.34% in cross bred, 13.10% in indigenous cattle and 36.54% in buffaloes) and simulation models based on certain assumptions (Malik 2018). The parameters like average lactation yield, average daily milk yield and average market value of animals were used to calculate the losses due to anestrus. Average value of different categories of animals is based on their market value depending on their age, species and lactation yield. Losses after calving period from 60 to 90 days were not incorporated for its calculation; average extended days open of 290 days. This value was assumed to depreciate @ 10% after third lactation and @ 20% after 5th lactation. Different categories of losses in dairy animals were estimated based on their prevalence rate in different ACZs of Punjab (Fig. 1).

Loss of milk yield: Milk yield loss from the anestrus lactating animals was estimated during the whole lactation period (290 days). It constituted the second largest component as illustrated in Table 1. The reduction of milk yield per animal per year was observed to be highest in buffaloes (27.90%) of ₹ 7545.4±311.7, followed by crossbred cattle (13.7%) of ₹ 3801.5±247.4 and indigenous cattle (12.7%) of ₹ 2330.2±172.9. In cows, average loss of US\$ 1.8/animal /day (₹ 117) for a period of 340–370 days

Table 1. Component wise economic losses due to anestrus of different species of dairy animals in different ACZs of Punjab

Category	AC zones	Losses (component-wise) (₹)					
		Milk yield loss	Veterinary charges	Labour charges	Replacement cost	Future calf reduction	Miscellaneous charges
<i>Crossbred cattle</i>							
	I	3590.1	593.9	20.5	23259.5	1284.5	93.1
	II	3926.2	606.6	20.8	23778.0	1297.5	95.4
	III	4885.4	813.6	28.2	26559.5	1761.5	127.5
	IV	3200.1	615.0	21.7	21310.0	1359.0	95.8
	V	3888.1	658.9	22.9	23517.0	1430.5	103.2
	VI	3318.9	536.2	18.5	12431.5	1155.5	84.1
	Mean	3801.5	637.4	22.1	21809.2	1381.4	99.8
	SE	247.4	38.7	1.34	1997.1	84.6	6.1
<i>Indigenous cattle</i>							
	I	1872.6	460.3	16.6	17805.5	622.2	85.0
	II	2292.6	566.5	20.4	11090.0	766.2	104.5
	III	2058.8	744.4	27.8	16110.0	1041.6	129.2
	IV	2859.2	729.0	26.4	16067.5	989.4	133.7
	V	2839.4	680.4	24.4	15000.0	917.1	126.2
	VI	2058.8	453.8	16.2	10355.0	605.7	85.5
	Mean	2330.2	605.7	22.0	14404.7	823.7	110.7
	SE	172.9	53.4	2.0	1224.4	76.3	9.0
<i>Buffaloes</i>							
	I	6458.1	1297.9	46.3	15700.0	1734.9	244.1
	II	7563.4	1407.9	49.7	12683.0	1863.9	269
	III	7815.9	1578.0	56.3	16009.0	2110.8	296.5
	IV	6900.9	1375.4	48.9	16393.0	1836.9	259.1
	V	8586.4	1478.9	51.6	19615.0	1936.8	287.5
	VI	7947.7	1558.3	48.8	14620.0	1832.1	270.1
	Mean±	7545.4	1449.4	50.3	15836.7	1885.9	271.1
	S.E	311.7	44.5	1.3	932.0	52.2	7.7

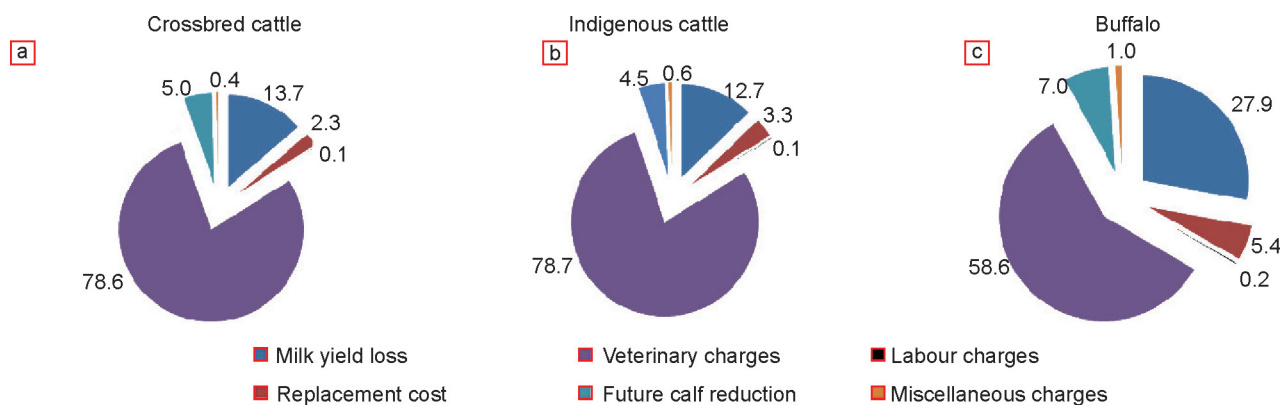


Fig. 1. Per cent contribution of different categories of losses to overall economic loss due to anestrus.

lactation has been estimated (DeVries 2011, Cattaneo *et al.* 2015).

Treatment cost: The total cost of treatment cost per animal per year was found to be ₹ 637.38±38.76 (2.29%) in cross bred cattle; ₹ 605.7±53.5 (3.3%) in indigenous cattle and ₹1449.4±44.5 (5.4%) in buffaloes. The highest treatment cost in buffaloes was due to higher occurrence of anestrus in the study area, higher medication charges and poor recovery from the anestrus condition. Comparable losses of ₹ 500 per animal to treat anestrus animals were reported by Kutty (2000) in lactating cows.

Extra labor engagement cost: It was assumed that one extra hour was spent per day to nurse the affected animal throughout the open days. The overall mean cost of additional labour was highest in buffaloes of ₹ 50.3±1.4 per animal per year (0.2%), followed by cross bred cattle of ₹1,074.0±106.6 per animal per year (0.1%) and indigenous cattle of ₹ 635.14±38.3 per animal per year (0.1%). The labour engagement cost varied among different Zones, which could be due differences in recovery period, prevalence rate and variation in wage rates.

Replacement cost of culled animals: Replacement cost of animals due to anestrus especially in older and unproductive animals (>5 lactation) contributed the major percentage loss among different categories of animals, viz. crossbred (78.8%), indigenous cattle (78.7%) and buffaloes (58.6%). The total cost of replacement of culled animals was highest in cross bred animals (₹ 21,809.2±1,997.1), followed by buffaloes (₹ 15,836.7±932.0) and indigenous cattle (₹ 14404.7±1224.5) in different ACZs.

Total cost of replacement cost due to anestrus was higher in high yielder cross bred animals than local animals and constituted the major proportion of total loss per animal per year. In cattle, loss due to replacement cost contributed the highest proportion of all losses. It was due to higher replacement cost of animal owing to their zero salvage value. However, in buffaloes, farmers were able to get some price of their unproductive animals from the organized slaughter houses. These results concurred with those of DeVries (2006) who also reported that the highest proportion of the total cost is contributed by cow replacement cost due to infertility.

The unproductive and older animals are culled from dairy herds to avoid further losses from such animals. Groenendaal *et al.* (2004) reported that replacement of animals is favorable when the marginal net profit expected for keeping cows in a herd will become lower than the average profit provided by the average cow.

Future calf reduction: The expected future calf crop loss per animal per year due to anestrus was estimated on the basis of an average number of open days to the total number of days of pregnancy along with the market value of the calf for the next replacement. The highest future calf loss was observed in buffaloes (₹ 1,885.9±52.2) followed by cross bred cattle (₹ 1,381.4±84.6) and indigenous cattle (₹ 823.7±76.4). It constituted the third major loss due to anestrus in different categories of dairy animals.

Miscellaneous cost: The miscellaneous costs included maintenance cost and extra feeding cost etc. during the anestrus period. The overall value of miscellaneous charges per animal per year was ₹ 99.8±6.1 (1.0%) in cross bred cattle; ₹ 110.7±9.0 (0.6%) in indigenous cattle and ₹ 271.1±7.7 (0.4%) in buffaloes. Highest miscellaneous costs were observed in buffaloes that could be due to smallest herd sizes and highest transportation costs for taking animal to the polyclinic from the farmer's house. Miscellaneous costs were also different in different zones that could be due to difference in average market values of extra feeding cost during the anestrus period.

Total economic losses of dairy animals due to anestrus in different ACZs of Punjab: The overall economic losses per animal per year due to anestrus have been presented in Table 2. The losses varied significantly among different categories of animals ($P < 0.01$) but non-significantly among different ACZs ($P > 0.5$). The total mean economic losses in crossbred cattle, indigenous cattle and buffaloes were ₹ 27,511.5±1227.6, ₹ 18,297.0±1317.5 and ₹ 27,038.7±1,128.1 per animal per year, respectively. Maximum losses were skewed towards buffaloes followed by indigenous cattle and cross bred cattle because of better value of buffalo milk in the market and higher prevalence rate of anestrus in buffaloes. From the post-hoc test among different ACZs, the overall mean loss per animal per year was ₹ 24,362.9±1,273.0 and didn't vary significantly ($P > 0.05$).

Table 2. Economic losses due to anestrus crossbred cattle, indigenous cattle and buffalo in different ACZs of Punjab and benefit cost analysis of control measures

Category	Agro-climatic Zones of Punjab							Benefit cost analysis					
	I	II	III	IV	V	VI	Mean±SE	Control measures (%)	Treatment coverage (%)	Total benefits per year (₹)	Cost of control per year (₹)	BCR	
Overall economic loss (₹)													
Crossbred cattle	28841.6	29724.5	34175.7	26601.7	29620.7	17554.8	27511.5±1227.6 ^b	86.7	57.3	13657.2	2500	5.5	
Indigenous cattle	20862.2	14840.2	20111.7	20805.2	19587.5	13575	18297.0±1317.5 ^a	86.8	59.8	9501.5	2000	4.8	
Buffalo	25481.1	23837	27866.6	26814.4	31956.2	26277	27038.7±1128.1 ^b	63.5	59.9	10267.9	2000	5.1	
Mean	25061.6±2454	22800.5±2957.1	27384.6±2407.0	24740.4±3481.6	27054.8±4284.3	19135.6±4326.5	24362.9±1273.0	74.2	59	10663.8	2000	5.3	

among different zones. The losses ranged from ₹ 19,135.6±4326.5 (Zone VI) to ₹ 27,384.6±2,407.0 (Zone III).

Different studies estimated different values of losses for extended open days in dairy animals. Methodological differences and economic context differences existed between different areas and time periods. In current study, one day delay in conception during the 290 days of lactating animals excluding the post-calving period of 100 days cost the farmer ₹ 78.13. The previous studies estimated one day of delay in conception in average producers to cause a loss of \$1.24 or ₹ 80.6 (DeVries and Conlin 2003) in the United States and loss of £2.41 (₹ 233.77) in the UK (Esslemont *et al.* 2000), loss of •0.28–1.10 (₹ 21.49–84.43) (De Vries and Conlin 2003); •0.06 –1.03(₹ 4.6–79.06) (Groenendaal 2004); •0.47–•0.79 (₹ 36.07–60.64) (Meadows 2005). Esslemont *et al.* (2000) also reported a loss of £6.52 (₹ 606.25) per day for a high producing cow.

Few studies reported contradictory findings. Pawshe *et al.* (2011) reported an estimated loss from anestrus to be around ₹ 193.00 per day in cow while Kumar *et al.* (2013) reported ₹ 372.90 per day in buffalo. Plaizier (1997) calculated the loss per open day to be •2.95(₹ 226.44) and Veerkamp (2002) found the loss to be •2.07 (₹ 158.89). The differences could be due to different components taken into consideration while calculating economic loss, different type of farming, variation in marketing value of animals and milk loss taken into consideration, lower prevalence of anestrus in animals in the current study.

Among various ACZs of Punjab, the most affected region was the Western region that included districts of Faridkot and Muktsar, and followed by border districts. The possible explanation could be poor awareness about management of anestrus in dairy animals, poor record keeping, small

dairy units hence less care and management, more engagement of farmers in agricultural operations leading to provision of poor quality fodder to their animals. All these causing nutritional deficiencies that have strong impact on reproductive performance of dairy animals. The least affected regions were the Flood plain region especially in urban and sub-urban areas. The farmers in these areas had commercialized their dairy business rearing high yielding animals. They have good awareness about anestrus. The veterinary facilities are also easily availability to these farmers, hence, this problem was not observed much in medium and large dairy herds in such areas.

Total benefits perceived by the dairy farmers per animal per year controlling anestrus in different ACZs of Punjab: The overall benefits simulated for the dairy farmers for controlling anestrus condition across different categories of animals in different ACZs of Punjab were ₹ 10,663.8 with higher benefits forgone estimated in cross bred cattle (₹ 13657.2) followed by buffaloes (₹ 10267.9) and indigenous cattle (₹ 9501.45), respectively. The benefit cost ratio of crossbred cattle, indigenous cattle and buffaloes were in the ratio of 5.46, 4.75 and 5.13, respectively, if the control measures (like mineral mixture, estrus detection, teaser bulls, comfort zone of animals etc.) were assumed to cost ₹ 2500 for crossbred cattle and ₹ 2000 for indigenous cattle and buffaloes. From the benefit cost analysis, it may be concluded that the farmers may get the highest returns if the control measures could be promoted efficiently to them. Inchaisri *et al.* (2009) estimated the economic losses due to non-optimal fertility in an average reproductive performance cow to be •34 per cow per year (₹ 2,609.84) as compared to the losses of •231 per cow per year (₹ 17731.56) in a good reproductive situation cow.

It may be concluded that the mean economic losses per

animal per year was higher in crossbred cattle and buffaloes, where the largest component was due to replacement cost followed by milk yield loss, future calf reduction and veterinary charges. Central Plain region in Punjab was highly affected by anestrus. Therefore, in order to control anestrus at farm level to improve, all aspects related to heat detection, appropriate preventive or therapeutic measure must be taken care off to control significant economic losses in reproduction and production.

ACKNOWLEDGEMENTS

The authors thankfully acknowledge the funds and support from GADVASU, Ludhiana and the cooperation from dairy farmers of Punjab to conduct this study.

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