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Influence of non-genetic factors on disposal pattern of Sahiwal cattle under an organized farm

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ABSTRACT

The present investigation was conducted to examine age/parity specific incidence of disposal and to assess the effect of various non-genetic factors on disposal of Sahiwal cattle maintained at the Institute. The analysis was carried out on data of 1,984 calving records of 519 Sahiwal cows born between 1985 and 2009, and 830 female calves born between 1986 and 2009. Traits considered in present study were abnormal calving, disposal of female calves up to age at first calving (AFC) and disposal of adult cows up to 4 lactations. The overall incidence of abnormal calving was 5.75% and was significantly affected by season and period of calving. Higher incidence of abnormal calvings were found during autumn and rainy seasons and it also revealed an increasing trend over the periods. Overall incidence of disposal of female calves up to AFC was 33.78%, comprising 9.11% due to culling and 24.67% due to mortality. Overall disposal of adult cows up to 4 lactations was 76.65%, comprising 11.85% due to mortality and 64.80% due to culling and was significantly affected by period of first calving. Major reasons of disposal were mortality during calfhood stage and culling during adult life. Maximum mortality was observed during first month of age. Therefore, intensive care of calves especially during first month of age against inclement weather conditions and improved breeding and management of cows to reduce involuntary culling would be expected to result in reduced likelihood of undesirable disposal of animals.

Key words: Abnormal calving, Culling, Disposal pattern, Mortality, Sahiwal

Sahiwal, an important milch breed of zebu cattle endowed with adaptability to perform well under harsh tropical climatic conditions, have witnessed serious erosion in last few decades in India. For genetic improvement of a breed, efforts need to be made to increase the intensity of selection, which becomes possible by increasing herd size and number of offspring reaching milking herd in next generation (Singh 1995, Singh *et al*. 2002), which will further facilitate in voluntary culling for low milk production. Disposal (comprising mortality and culling of animals) of animals is a main constraint in achieving the goal. Knowledge of age/parity specific incidence and non-genetic factors associated with disposal of animal is essential, so that appropriate breeding and management strategies could be developed for accelerating the pace of genetic progress for this important milch breed of zebu cattle.

The response variable in mortality and culling i.e. disposal pattern is quite often dichotomous or binary in nature (Guerra 2004, Tokuhisa *et al.* 2011). Under such conditions of binary nature of response variable, probit or logistic regression can facilitate effectively in exploring the relationship between the dependent and independent variables as well as for predicting response (Guerra *et al.* 2006, Hadley *et al*. 2006, Manoj 2013). Therefore, in the present investigation, logistic regression model approach was used to assess effect of various non-genetic factors on incidence of disposal, viz. abnormal calving, disposal of female calves upto AFC and disposal of adult cows up to 4 lactations.

MATERIALS AND METHODS

The data for the present investigation were collected from the records of Sahiwal cattle maintained at the Institute. Data of 1,984 calving records pertaining to 519 Sahiwal cows from 62 sires were used to analyze the disposal pattern of adult cows. The animals were born between 1985 and 2009. Records of 830 female calves, born between 1986 and 2009 to 56 sires, were utilized to analyse disposal pattern in female calves up to entry into milch herd. The

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information on total number of lactations completed by all cows, date of all calvings, type of calving, i.e., normal vs abnormal (abortion, still birth and pre-mature birth were considered as abnormal calving), date of birth of calf, birth weight of calf, date of first calving of heifers and reason of disposal of adult cows and female calves were recorded.

The data were classified according to season of birth or calving, period of birth or calving, parity order of cows and birth weight of calves to assess the percent incidence and the effect of non-genetic factors on the disposal pattern. The months were grouped into 4 seasons based on climatic conditions as winter (December to March), summer (April to June), rainy (July to September) and autumn (October to November). Years were grouped in to period of birth as 1986–1989, 1990–1993, 1994–1997, 1998–2001, 2002–2005 and 2006–2009; and period of calving or first calving as 1988–1992, 1993–1996, 1997–2000, 2001–2004, 2005–2008 and 2009–2013. Parity order of cows was classified as first, second and third, fourth and fifth, and sixth and above parities. Calves were classified on the basis of birth weight into 3 groups, viz. < 17 kg, 18–23 kg and > 24 kg.

Traits studied: Disposal pattern, viz. abnormal calving, disposal of female calves up to AFC and disposal of adult cows up to 4 lactations were analysed in the present study. Incidence of abnormal calving was calculated as per cent prenatal calf mortality due to abortion, premature birth and still birth. Disposal up to AFC was estimated as incidence of disposal (culling and mortality) of female calves and heifers up to entry into milch herd. Of the total lifetime milk yield (2,437,087.42 kg) around 80% was recorded up to 4 lactations (1,882,115.42 kg), so in present study productive herdlife of Sahiwal cows was considered up to 4 lactations. For analysis of disposal of adult cows, it was therefore, computed as cumulative incidence of disposal (mortality and culling) during first, second, third and fourth lactations. For study of mortality and culling rates in different age groups/parities, female calves were grouped in 6 age groups (mo.) as 0–1, 1–3, 3–6, 6–9, 9–12 and 12-AFC and adults cows according to their number of lactations completed as 1, 2, 3 and 4.

Statistical analysis of data: The data analysis was carried out by Logistic regression model of Statistics Analysis System (SAS version 9.3) Programme. Non-genetic factors considered were season of calving, period of calving and parity order of cows for abnormal calving, season of birth, period of birth and birth weight of calves for disposal upto AFC, and season of first calving and period of first calving for disposal up to 4 lactations.

The following dichotomous logistic regression model was used:

$$\ln\left[\frac{p}{1-p}\right] = \beta_0 + \sum_{j=1}^{c} \beta_j X_j$$

where, ln denotes the natural logarithm, p is the probability that the dependent variable equals a case, β_0 is the intercept from the linear regression equation (the value of the criterion when the predictor is equal to zero), $\beta_j X_j$ is the regression coefficient multiplied by some value of the predictor.

RESULTS AND DISCUSSION

Abnormal calving: Incidence and effect of non-genetic factors

Incidence: The average incidence of abnormal calvings was 5.75% out of 1,984 calvings. This was in agreement with the findings of Mukherjee and Tomar (2000), and Shahi and Kumar (2006) for different crossbreds of Sahiwal cattle. Lower estimates than the present study were reported by Abbas (2005) and Banik and Naskar (2006) for Sahiwal cattle. However, higher estimates were also obtained by some workers, which ranged from 7.10 to 11.32% in different breeds and crossbreds of dairy cattle (Singh 2001, Singh *et al.* 2002, Atrey*et al.* 2005, Singh *et al.* 2011).

Effect of non-genetic factors: The wald Chi-square estimates for different non-genetic factors indicated significant influence of season (P<0.01) and period of calving (P<0.05) on incidence of abnormal calving whereas parity order of cows had no significant influence (Table 1). Results (Table 2) revealed higher odds value in favour of abnormal calvings in cows calved during autumn (1.00) in comparison to others (i.e. 0.324, 0.297 and 0.394 in winter, summer and rainy season, respectively), which means likelihood of abnormal calvings in summer, winter and rainy season were 70.3, 67.6 and 60.6 %, respectively, lesser than autumn. Odds values in favour of abnormal calvings were higher in cows those calved during fifth period (1.602) than rest of the periods (<0.001, 0.455, 0.671, 0.994, 1.000 in first, second, third, fourth and sixth periods, respectively) revealing an increasing likelihood of abnormal calving across the periods. Effect of parity was nonsignificant on incidence of abnormal calving.

The most favourable seasons for normal calvings were winter and summer whereas autumn calvers were more prone to calving abnormalities. This was in agreement with findings of Mukherjee and Tomar (2000). Last trimester of gestation plays the most critical role in determining type of calving, therefore in autumn higher incidence of abnormal calvings could be due to high parasitic load and hot and humid weather conditions in the preceding rainy season encountered during the last trimester of pregnancy. In present study no abnormal calving was observed during the first period, thereafter it showed increasing trends over the periods up to fifth period. This could be due to variation

Table 1. Wald Chi-square values for abnormal calvings in Sahiwal cows

Effect	df	Wald Chi-square value
Overall	11	37.13**
Season	3	21.79**
Period	5	14.00*
Parity	3	3.18

* Significant (P<0.05); ** Significant (P<0.01).

in managemental and environmental factors across the periods. Significant effect of period on abnormal calving was also reported by Mukherjee and Tomar (2000) for Karan Swiss (Brown Swiss × Sahiwal), Singh (2001) for Karan Fries (crossbred of Tharparkar and Holstein-Friesian) and Abbas (2005) for Sahiwal cattle. On the other hand, contrary results were obtained by Singh *et al.* (2002) in Friesian cattle. Although parity did not significantly influence the incidence of abnormal calving but odds value in favour of abnormal calving was higher in first calvers and was lesser during fourth and fifth parities than rest of parity groups under study. Taraphder (2002) and Manoj (2013) also reported higher incidences of abnormal calvings during first parity in Murrah buffaloes.

Disposal of female calves up to AFC: Age group specific incidence and effect of non-genetic factors

Age group specific incidence: Overall disposal of female calves up to AFC was 33.78%, out of which 24.67 % left the herd because of mortality and 9.11% left because of culling (Table 3). It means only 66.22% of female calves born at NDRI herd entered in to the milch herd indicating replacement rate of 66.22% (on total female calf born basis) in Sahiwal cattle. Lower mortality rate up to AFC in comparison to the present study was reported by some workers ranged from 13.70 to 17.52 % (Singh *et al.* 2002, Shahi and Kumar 2006, Atrey*et al*. 2005). Higher mortality rate in comparison to the present study was reported by Banik and Naskar (2006) in Sahiwal as 35.6%. In most of the studies culling rate up to AFC was reported to be higher than present study ranging from 11.57 to 31.05 % (Atrey*et al*. 2005, Shahi and Kumar 2006, Singh *et al.* 2002). Better management practices of NDRI herd might cause low involuntary culling.

If we see mortality and culling rates at different months of age, it roughly seems to have decreasing trend for mortality and increasing trend for culling rates as the age increases. Maximum mortality rate was reported up to first month (13.98%) of age, which indicated that up to first month of age calves were most vulnerable to die. Since in practice female calves are only culled after expression of their physical traits, therefore in early months of age female calves were rarely culled and during the age group of 12 month to AFC maximum culling (3.70%) of female calves was observed.

Effect of non-genetic factors: The season of birth, period of birth and birth weight of calf had no significant influence on disposal of female calves and heifers up to AFC (Table 4). The estimates of odds ratio for different factors considered in the model are given in Table 5. Results revealed that although disposal of female calves up to AFC was not significantly affected by any of the non-genetic factors considered in the study, but higher incidence of disposal were found in rainy season, which may be attributed to higher incidence of gastro-enteric problems encountered in this season. Regarding the period there was no definite trend of disposal of calves across the periods. If we see the effect of birth weight of calves, calves having less than 17 kg birth weight had more incidence of disposal and the calves having birth weight more than 24 kg the incidence of disposal were minimum.

Table 2. Effect of various non-genetic factors on incidence of abnormal calvings in Sahiwal cows (expressed as odds values)

Season of calving effect	Winter	Summer	Rainy	Autumn		
Odds value	0.324	0.297	0.394	1.000		
Period of calving effect	1988–92	1993–96	1997–00	2001–04	2005–08	2009–13
Odds value	<0.001	0.455	0.671	0.994	1.602	1.000
Parity order effect	1	2 and 3	4 and 5	6 and above		
Odds value	1.230	1.029	0.705	1.000		

Table 3. Disposal (culling and mortality) rate in various age groups of female calves of Sahiwal breed

Pattern of disposal	Age groups of calves (mo.)						
	0-1	2–3 Jan	3–6 Mar	6–9 Jun	9–12 Sep	12-AFC	Total (Birth-AFC)
Mortality (%)	13.98 (116)	4.35 (31)	1.32 (9)	1.82 (12)	0.79 (5)	2.42 (15)	24.67 (188)
Culling (%)	0.12 (1)	0.00 (0)	2.05 (14)	2.12 (14)	1.11 (7)	3.70 (23)	9.11 (59)
Total disposal (%)	14.1 (117)	4.35 (31)	3.37 (23)	3.94 (26)	1.90 (12)	6.12 (38)	33.78 (247)

Number of observations are with in parentheses (N=830)

Table 4. Wald Chi-square value for disposal of Sahiwal female calves and heifers up to AFC

Effect	df	Wald Chi-square value
Overall	10	13.6485
Season	3	5.1075
Period	5	4.7337
Birth weight	2	3.2514

Table 5. Effect of various non-genetic factors on incidence of disposal of Sahiwal female calves and heifers up to AFC (expressed as odds values)

Season of first calving Effect	Winter	Summer	Rainy	Autumn		
Odds value	1.211	1.309	1.799	1.000		
Period of first calving effect	1986–89	1990–93	1994–97	1998–01	2002–05	2006–09
Odds value	1.307	1.180	1.630	1.266	1.022	1.000
Birth weight of calves effect	< 17 kg	18–23 kg	> 24 kg			
Odds value	1.639	1.152	1.00			

Table 6. Disposal (culling and mortality) rate in various parities of adult Sahiwal cows

Pattern of disposal	Parity				
	1	2	3	4	Total (up to 4 lactations)
Mortality(%)	2.50 (13)	3.36 (50)	3.13 (11)	2.87 (8)	11.85 (47)
Culling(%)	11.37 (59)	17.90 (80)	17.61 (62)	17.92 (50)	64.80 (251)
Total disposal (%)	13.87 (72)	21.25 (95)	20.74 (73)	20.79 (58)	76.65 (298)

Number of observations are with in parentheses (N= 519).

Table 7. Wald Chi-square value for disposal of adult lactating Sahiwal cows up to 4 lactations

Effect	df	Wald Chi-square value
Overall	8	29.31**
Season	3	7.40
Period	5	22.67**

* Significant (P<0.05); ** Significant (P<0.01).

Disposal of adult cows up to 4 lactations: Parity specific incidence and effect of non-genetic factors

Parity specific incidence: Overall incidence of disposal of adult cows up to 4 lactations was 76.65% out of which 11.85% due to mortality and 64.80% due to culling (Table 6). Trends of mortality and culling were inconsistent over the lactation order. Highest mortality and culling were observed during second lactation.

Effect of non-genetic factors: The influence of period of first calving was highly significant (P<0.01) on disposal of adult cows up to 4 lactations (Table 7) whereas effect of season of first calving was nonsignificant.

Results (Table 8) revealed that odds ratio in favour of disposal up to 4 lactations was higher in cows those had their first calving during sixth period (1.000) in comparison to other periods and likelihood of disposal up to 4 lactations was significantly lower in cows those first time calved during second and third periods (83 and 84 %, respectively) in comparison to sixth period. Trends for disposal were inconsistent and irregular across the periods which might be due to variation in environmental and management practices.

Table 8. Effect of various non-genetic factors on incidence of disposal of adult Sahiwal cows upto 4 lactations (expressed as odds value)

Season of first calving effect	Winter	Summer	Rainy	Autumn		
Odds value	0.298	0.332	0.385	1.000		
Period of first calving effect	1986–89	1990–93	1994–97	1998–01	2002–05	2006–09
Odds value	0.253	0.170	0.161	0.336	0.219	1.000

Our results revealed that an overall incidence of abnormal calving was 5.75% and was significantly affected by season (P<0.01) and period (P<0.05) of calving. Autumn calvers were more prone to calving abnormalities, which could be due to hot and humid weather conditions in months preceeding autumn, encountered during last trimester of pregnancy. Therefore, better feeding and management of cows, especially during last trimester of pregnancy would result in lower incidence of abnormal calvings. Major reasons of disposal of animals were mortality in female calves and culling in adult cows. Maximum mortality among female calves was during first month of age (13.98%), therefore, proper care of calves especially in this age group against adverse weather conditions would lead to reduced incidence of calf mortality. Higher culling rate in adult cows was observed in second lactation and onward. Therefore, there is a need to minimize involuntary culling of cows by providing better feeding, breeding and management conditions at the herd.

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