



Analysis of Jersey crossbred cows for lactation specific demographic parameters

LALMUANSANGI¹, ISHANI ROY¹, MOKIDUR RAHMAN¹, AJOY MANDAL¹ and RAJALAXMI BEHERA¹✉

National Dairy Research Institute, Eastern Regional Station, Kalyani, West Bengal 741 235 India

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ABSTRACT

In present study, lactation specific demographic analysis was carried out on 1728 records of Jersey crossbred cows maintained at Eastern Regional Station (ERS), ICAR-NDRI, Kalyani, West Bengal over a period of 40 years (1980-2019). The survival rate was 79% in first lactation and followed a decreasing trend with lactation order. The stayability for first lactation was one; decreased in subsequent lactations. Stayability was noted as 0.365, 0.052 and 0.015 at fourth, eighth and eleventh lactation respectively, indicating that only 36.5, 5.2 and 1.5 % of cows remained in the herd in these lactation period. Approximately 79% of total cows present in the herd belonged to first 4 lactations while less than 3% cows belonged to 9 and above parities indicating abundance of younger cows. The expected herd life was observed as 2.75, 2.222 and 1.721 in first, third and fifth lactation and decreased with parity order. The probability of cow being lost from the herd after first lactation was 21%. The present study concluded that the herd comprised of younger cows with a required annual replacement rate of 21% to keep the herd size constant.

Keywords: Disposal rate, Expected herd life, Jersey crossbred, Stayability, Survival rate

Knowledge on lactation specific demographic parameters will help to design optimum breeding program, estimate annual culling and disposal rate to make the herd size constant and ultimately genetic improvement of the herd (Kumar *et al.* 2013, Upadhyay *et al.* 2014). Lactation specific demographic parameters include survival rate (P_x), disposal rate (Q_x), stayability (L_x), herd structure and expected herd life (E_x). Crossbred cows play significant role in Indian economy and contribute more than one-fourth share (27.68%) of national milk pail (BAHS 2020). The production and reproduction performance of Jersey crossbred cows provide genetic improvement of native cattle germplasm (Vijayakumar *et al.* 2019). Comprehensive studies on fitness traits like survivability, lactation specific stayability is essential to understand the adaptability of the genotype to diverse agro-climatic conditions prevailing in India. Therefore, the cattle herd of ERS, ICAR-NDRI, Kalyani, West Bengal was analyzed to study lactation specific demographic parameters of Jersey crossbred cows.

MATERIALS AND METHODS

The present study was carried out on 1728 records of Jersey crossbred cows maintained at Eastern Regional Station (ERS), ICAR-National Dairy Research Institute (NDRI), Kalyani, West Bengal over a period of 40 years (1980-2019) and lactation wise demographic parameters

like culling rate, mortality rate, survival rate (P_x), disposal rate (Q_x), stayability (L_x), herd structure and expected herd life (E_x) were analyzed.

Survival rate (P_x): It is calculated for each parity by dividing the number of cows that calved by the number of cows in the opportunity group. Thus, it is the probability of an animal being present at lactation X in the herd to the next lactation of X+1.

Disposal rate (Q_x): It is the probability of a cow, assuming survival to lactation X, of dying or culling before lactation X-1 and calculated as per Schons *et al.* (1985). It is complementary to Survival rate (P_x) i.e $Q_x = 1 - P_x$

Stayability (L_x): This is calculated as the probability of a cow at first lactation present in herd to lactation X and estimated as number present at lactation X divided by the number alive at first lactation.

$$L_x = n_x/n_0$$

where, n_x = number of cows surviving at lactation X; n_0 = number of cows at first lactation.

The stayability at first lactation was taken as unity and hence $L_0 = 1.0$.

Expected herd life (E_x): It is estimated as the sum of probability of an animal of a given lactation remaining in the herd (P_x) each succeeding lactation up to the last lactation calculated as per Ahmed *et al.* (1992).

Herd structure: Lactation specific herd structure was calculated as described by Greer *et al.* (1980). Lactation specific loss from the herd (q_x) is the probability of the cows being lost from the herd at each lactation. Lactation specific distribution of cows present in the herd (p_x) is the probability of cows in each lactation, to remain in the herd.

Present address: ¹National Dairy Research Institute, Eastern Regional Station, Kalyani, West Bengal. ✉Corresponding author email: drrajlaxmi.10@gmail.com

Table 1. Lactation wise disposal pattern and herd structure of Jersey crossbred cows

Lactation No.	Culling rate (%)	Mortality rate (%)	Disposal rate (%)	Herd Structure	
				(q _x)	(p _x)
1	15.23	5.46	21	0.21	0.296
2	17.06	6.29	23	0.171	0.220
3	17.86	9.64	27.5	0.151	0.163
4	14.97	8.55	24	0.087	0.108
5	14.6	10.94	25.5	0.068	0.079
6	23	12	35	0.068	0.057
7	40.98	14.75	56	0.066	0.035
8	33.33	7.40	41	0.021	0.015
9	35.3	5.88	41	0.013	0.009
10	18.2	18.18	36	0.0076	0.006
11	25	25	50	0.0075	0.004
12	40	20	60	0.005	0.002
13	100	-	100	0.003	0.0008
Overall	18.05	8.04	26.09		

RESULTS AND DISCUSSION

Culling rate: Culling rate in first lactation was 15.23% while higher culling rate was observed in 7th lactation (40.98%) and 13th lactation (100%). The overall culling rate was 18.05%. Higher estimates of overall culling rate of 20.96% and 25.01% was observed in Karan Fries breed as well as Karan Swiss breed of cattle by Singh and Gurnani (2004), Maher *et al.* (2015) in Tharparkar cows and Upadhyay *et al.* (2014) in Sahiwal cows. In Irish dairy cattle, Maher *et al.* (2008) observed 21.3% culling rate. Rilanto *et al.* (2020) further observed 26.24% culling rate in Estonian dairy cows. High overall culling rate per lactation with 61.1% was observed by Fahim *et al.* (2021). Lower overall culling rate of 17.38% in Kankrej cattle was reported by Madhavatar *et al.* (2019). In first lactation, lower culling rate than the present finding was found in Sahiwal (14.38%) by Upadhyay *et al.* (2014) and higher culling rate in first lactation was observed by Maher (2014) in Tharparkar cattle (25.3%) and Madhavatar *et al.* (2019) in Kankrej cattle (18.75%). The present finding indicated that the culling rate was moderate but still can be improved through better management practices.

Mortality rate: The overall mortality rate of crossbred cows was 8.044% (Table 1). The mortality rate in the first lactation of crossbred cows was observed as 5.46%. Highest mortality rate (25%) was observed in the 11th lactation. Lower estimates of the overall mortality rate was observed as 3.33% by Maher *et al.* (2015) in Tharparkar cows, 4.65% in Sahiwal cows by Upadhyay *et al.* (2014) and 1.34% by Madhavatar *et al.* (2019) in Kankrej cattle. Higher mortality rate was reported by Abbas (2005) in Sahiwal as 15.4%. Chauhan *et al.* (2018) in Deoni and Holdeo crossbred cattle as 12.34%. In Eastern Cape Province of South Africa, on-farm mortality of 13.7% in dairy cows was observed by Diniso *et al.* (2021). Average on-farm mortality of 9.3% in dairy cows was observed by Motus and Niine (2022).

Lower mortality rate in first lactation was found in Sahiwal (3.59%) by Upadhyay *et al.* (2014) and by Maher (2014) in Tharparkar cattle (5.4%).

Herd structure: At the first lactation, the likelihood of the cows to be disposed from the herd due to culling and death (q_x) was 0.21 (Table 1) which means that 21% of the cows were leaving the herd after the first lactation of cow ends. Accordingly, replacement of the heifers was required to maintain the herd size. The percentage of the cows leaving the herd in lactation 2 and 3 was 17.1% and 15.1%, respectively; followed by a decreasing trend with lactation order (Table 1). Kumar *et al.* (2013) reported 0.23, 0.21, 0.20, 0.064 losses in the first, second, third and sixth lactation in Frieswal cattle. Upadhyay *et al.* (2014) also reported 0.18, 0.22, 0.17 and 0.061 losses in the first, second, third and sixth lactation in Sahiwal cattle. Higher disposal of animals from the herd was observed by Maher (2014) in Tharparkar cows as 0.30, 0.201, 0.167 and 0.054 in the first, second, third and sixth lactation.

The percentage of the cows presently staying in the herd showed that greater than 1/4th (29.6%) of the total herd were included in the first lactation and the remaining 22% comprised of the second lactation. The total number of females present in the herd up to 4th lactation was 78.8% while comprised less than 3% cows belonged to 9th and above lactations. These findings were almost similar to Upadhyay *et al.* (2014) in Sahiwal cattle and Maher (2014) in Tharparkar cows. This indicated that the herd of Jersey crossbred cattle comprised of younger females.

Survival (P_x) and disposal rate (Q_x): The survival rate observed was 79% in first lactation, indicating that a cow surviving up to the first lactation had 79% chance to be in the second lactation. Similar survival rate of 79% was also reported in Hariana cows by Kumar *et al.* (2010) in the first parity. The overall disposal pattern of the present study was 26.09%. Dongre *et al.* (2017) observed the overall disposal pattern of Tharparkar cows as 29.88%. The disposal rate was lowest in the first parity 21%. Saha *et al.* (2012) in Karan Swiss cattle also observed disposal rate of 20% in the first lactation. The survival rate declined till 3rd lactation (0.725); followed by increase in 4th lactation (0.76); decreased up to 7th lactation (0.44), thereafter the trend was inconsistent and least survival rate (0.40) observed in 13th lactation. Higher value of survival rate than the present

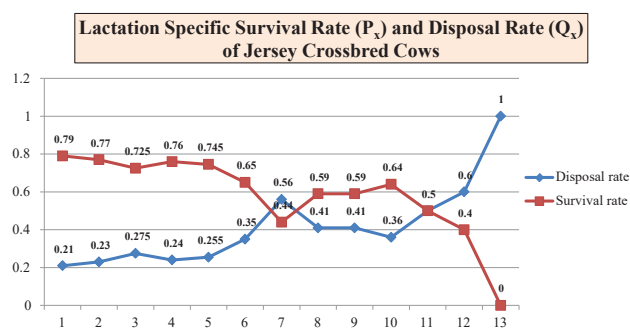


Fig. 1. Lactation specific Survival Rate (P_x) and Disposal Rate (Q_x) in different lactation.

estimates were reported by Shahi and Kumar (2012) for Sahiwal cattle (89.57%) in the first lactation and Upadhyay *et al.* (2014) for Sahiwal cattle (82%) in the first lactation. Lower value of survival rate than the present findings were reported by Kumar *et al.* (2013) for Frieswal cattle (76.1%) and Vinothraj *et al.* (2017) for Jersey $\times$ Red Sindhi crossbred cows (65%). Maher (2014) observed 70% in Tharparkar cattle and Dash *et al.* (2016) observed 73% in Karan Fries cattle in the first lactation. These differences in the survival rate and disposal rate could be due to different breed groups, culling and disposal policies adopted in each farm along with the differences in the management.

Stayability (L_x): Present study revealed that the chance of the cows to stay in herd reduced along with parity (Fig. 2). It was observed that the stayability at the 7th and 11th lactation was 0.119 and 0.015. Therefore proper care and management should be taken to improve stayability. This result agreed with results of Upadhyay *et al.* (2014) in Sahiwal cattle and Maher (2014) in Tharparkar cows. However, lower stayability than the current study was reported by Kumar *et al.* (2013) and Vinothraj *et al.* (2017).

Expected herd life (E_x): The expected herd life was 2.75 at the end of first lactation which means cows in first lactation were expected to be living in their herd for 2.75 more lactations which follows declining trend (Fig. 2). Lower values of the expected herd life than the present study by Kumar *et al.* (2013), Upadhyay *et al.* (2014), Maher (2014), Dash *et al.* (2016) and Vinothraj *et al.* (2017) at the end of first lactation. Higher expected herd life of 3.14 lactations at the end of first lactation was noted by Shahi and Kumar (2012) in Sahiwal cattle.

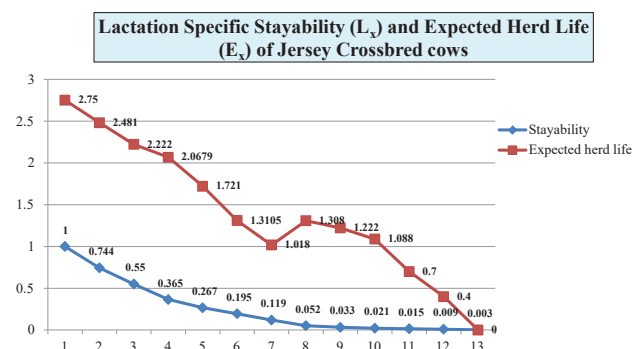


Fig. 2. Lactation Specific Stayability (L_x) and Expected Herd Life (E_x) of different lactation.

The overview of the results revealed that the survival rate (79%) of Jersey crossbred cows was moderate. The expected herd life at the end of first lactation was also low to moderate (2.75). The overall culling rate and mortality rate (18.05% and 8.044%) was found to be moderate indicating the herd is in a good condition. The differences in the culling and mortality rate in various farms could be due to different culling and mortality policy adopted in each farm along with different management strategies. The total number of females present in the herd up to 4th lactation was nearly 79% indicating abundance of young cows in herd which means that based on these results the herd structure was in

ideal condition. The probability of cow being lost from the herd due to disposal in first lactation was 0.21, indicating requirement of 21% replacement rate to maintain the herd size constant. This study helps us to know the status of the herd and serves as an important tool whether lack or improvement is needed in the herd. Evaluation of lactation specific demography helps in formulating better breeding plans and management strategies for upgradation of the herd.

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