Effect of non-genetic factors on various economic traits in Karan Fries crossbred cattle

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Received: July 2014 / Accepted: December 2014

Abstract  Data of 681 cows were collected for a period of 15 years, and analysed to see the effect of non-genetic factors on different economic traits in Karan Fries crossbred cattle. The overall least squares means of age at first calving (AFC), service period (SP), 305 days or less milk yield (305DMY), total milk yield (TMY), lactation length (LL), preceding dry period (PDP), calving interval (CI), average milk yield per day of lactation length (MY/LL) and average milk yield per day of calving interval (MY/CI) were 1043.40±6.64 days, 133.66 ± 3.89 days, 4113.61±55.90 kg, 4677.84±50.35 kg, 365.10± 3.34 days, 67.93 ± 2.12 days, 439.03±5.39 days, 12.93±0.99 kg and 11.08±0.13 kg respectively. It was observed that the period of birth was significant (P<0.01) on age at first calving. Similarly season of calving and period of calving was also significant (P<0.05) on service period, 305 days or less milk yield and milk yield per day of calving interval, while season of calving was significant (P<0.01) on total milk yield and milk yield per day of lactation length. Effect of period of calving was also significant (P<0.01) on age at first calving, 305 or less milk yield, total milk yield, lactation length, milk yield per day of lactation length and milk yield per day of calving interval. Parity was significant (P<0.05) on service period, 305 days or less milk yield, total milk yield, lactation length, calving interval, milk yield per day of lactation length and milk yield per day of calving interval.

Keywords  Non-genetic factors, economic traits, Karan Fries

Introduction

The native dairy cattle have low genetic potentials for milk production, mature late and have a delayed conception coupled with long calving intervals. But, have excellent qualities such as adaptability to hot climatic conditions, resistance to diseases and general thriftiness under inferior feeding and managemental conditions. Whereas, high producing specialised dairy breeds from temperate region when introduced to tropical and subtropical zones generally have a reduced performance in terms of productivity and reproduction which may be due to lack of adaptability to hot climatic conditions and susceptible to tropical diseases. Under such circumstances (Thomas et al., 2012), the productivity of indigenous animals could be increased by crossbreeding the low yielding nondescript cows with high yielding suitable exotic breeds for high milk yield, early sexual maturity and with sufficient capacity to withstand the direct and adverse effects of tropical climatic conditions. The development of Karan Fries was started in 1971 with 62.5% level of Holstein inheritance (Gurnani et al., 1986).

Therefore, the purpose of the study is to see the environmental impact on the productive performance but also on reproductive efficiency of the dairy animals. Effect of environmental factors is significant as Indian climate experience the extreme of weather conditions, which make animals uncomfortable and affect their performance adversely. Production and reproduction traits of dairy animals are low to moderately heritable which indicates that the major part of variation in these is governed by environmental factors and this effect of environment are minimized by efficient managemental practices. As a result, efficient management of animals during adverse condition is the key factor to maintain animal productive and reproductive efficiency at optimal level. Hence the study was undertaken with the objective to determine the effect of non genetic factors on different economic traits in Karan Fries crossbred cattle.
Materials and Methods

The study was conducted at National Dairy Research Institute located at an altitude of 250 metres above the sea level, in the indo-gigantic alluvial plains at 29 degree 42'N and latitude 72 degree 54' E longitude. The climate is subtropical in nature with temperature ranging between 2°C winter and 45 °C in summer respectively. The area receives an annual rainfall of 760 - 960 mm and relative humidity 41-85%.

Data comprises of 681 lactation records production and reproduction of Karan Fries cattle from 1998 to 2012 were utilized (15 years) for the studies. The lactation records of 250 days and above were considered in the study to see the effects of season, period and parity on various economic traits. The data were classified and coded according to different seasons; winter (December - March), summer (April - June), rainy (July - September), autumn (October - November) and period of calving 1998-2000(I), 2001-2003 (II), 2004-2006 (III), 2007-2009 (IV) and 2010-2012 (V); For AFC- period of birth; 1995-1997 (I), 1998-1999 (II), 2000-2003 (III), 2004-2006 (IV) and 2007-2009 (V) and parities (1-6) to observe the effect of non genetic factors on the traits. The traits included in the study were; age at first calving (AFC), service period (SP), 305 days or less milk yield (305DMY), total milk yield (TMY), lactation length (LL), preceding dry period (PDP), calving interval (CI), average milk yield per day of lactation length (MY/LL) and average milk yield per day of calving interval (MY/CI).

Statistical analysis

The data were subjected to Least-Squares Technique (Harvey, 1975) for the effects of seasons, period and parity on AFC, SP, 305DMY, TMY, LL, PDP, CI, MY/LL and MY/CI. Duncan's Multiple Range Test (DMRT) was used to test the significance of differences between treatments' means. The Least Squares Analysis model used is given below:

For at first calving:

\[ Y_{ijk} = \mu + S_i + P_j + A_k + e_{ijkl} \]

Where,

\[ Y_{ijk} = \text{Dependent trait (AFC) of } k^{th} \text{ cow born in } i^{th} \text{ season and } j^{th} \text{ period} \]
\[ \mu = \text{Overall mean} \]
\[ S_i = \text{Effect of } i^{th} \text{ season of calving (i=1-4)} \]
\[ P_j = \text{Effect of } j^{th} \text{ period of calving (j=1-5)} \]
\[ A_k = \text{Effect of } k^{th} \text{ parity (k=1-6)} \]
\[ e_{ijkl} = \text{Random error, NID with zero and constant variance (0,\sigma^2)} \]

For others traits:

\[ Y_{ijk} = \mu + S_i + P_j + A_k + e_{ijkl} \]

Where,

\[ Y_{ijk} = \text{Dependent trait (AFC) of } i^{th} \text{ cow born in } i^{th} \text{ season, } j^{th} \text{ period and } k^{th} \text{ parity} \]
\[ \mu = \text{Overall mean} \]
\[ S_i = \text{Effect of } i^{th} \text{ season of calving (i=1-4)} \]
\[ P_j = \text{Effect of } j^{th} \text{ period of calving (j=1-5)} \]
\[ A_k = \text{Effect of } k^{th} \text{ parity (k=1-6)} \]
\[ e_{ijkl} = \text{Random error, NID with zero and constant variance (0,\sigma^2)} \]

Results

Age at first calving

Overall least squares means of age at first calving was 1043.40 ± 6.64 days (Table 2). Season of birth on AFC was not significant while period of birth was significant on AFC (P<0.01). Cows born in winter season had shortest AFC (1035.94 ± 10.28 days) and autumn born cows had longest AFC (1049.60 ± 15.17 days). The period shown maximum and minimum AFC were II (1053.18 ± 14.14 days) and I (997.15 ± 14.21 days).

Service period

The overall least squares means for service period was 133.66 ± 3.89 days (Table 2). Season has no significant influence on service period. Cows calved during winter season has the longest service period (135.18±4.67 days) and autumn season was shortest (129.94±6.25 days). Both period of calving and parity was significant (P<0.05) on service period. Cows in six lactation and above showed longest service period (146.56±11.46 days), while shortest was observed in fifth lactation (121.06±10.72 days).

305 milk yield

The overall least squares means of 305 days milk yield in the present study was 4113.61 ± 55.90 kg. Season of calving was significant (P<0.05) on 305DMY. It was observed that autumn calvers showed highest 305DMY (4341.76 ± 106.63 kg). Cows calved in rainy season showed the least 305DMY (3909.03 ± 91.60 kg). Period also shown significance influence (P<0.01) on 305DMY. Parity had statistical significance (P<0.01) on 305DMY. Animal in fourth lactation showed maximum 305DMY (3909.03 ± 91.60 kg) while first lactation cows showed lowest 305DMY (3436.71 ± 66.72 kg)

Total milk yield

The overall least squares mean total milk yield was 4677.84 ± 50.35 kg (Table 2). Season of calving was significant (P<0.01)
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Cows calved during the autumn season had maximum total TMY (4894.80 ± 96.05 kg) while minimum was in rainy season (4425.01 ± 82.51 kg). Period of calving was also significance on TMY (P<0.01). It was observed that those cows calved during IV-period showed maximum TMY (5170.47 ± 76.12 kg) whereas cows calved during I-period are with least TMY (4055.86 ± 115.50 kg). Parity also shown significant influence (P<0.01) on TMY and highest TMY was observed in third lactation (4848.42 ± 93.46 kg).

Lactation length

The overall least squares means for LL was 365.10 ± 3.34 days (Table 3). Season was not significant on lactation length. Period of calving had significant influence on lactation length (P<0.01). Cows calved during V-period had maximum LL (375.17 ± 5.36 days). Parity had significant influence on lactation length (P<0.01). Cows in the first lactation showed longer LL (391.23±3.70 days) as compared those cows in the fifth lactation which showed minimum LL (346.42±9.87 days).

Dry period

Overall least squares means of dry period was 67.93 ± 2.12 days. Season of calving, period of calving and parity had no statistical significant on preceding dry period. The longest dry period was observed in autumn calvers (70.03 ± 2.67 days) while shortest was observed in rainy season (66.42 ± 2.38 days).

Calving interval

The overall least squares means of calving interval was 439.03 ± 5.49 days. Season of calving had non-significant influence on calving interval. Longest (447.13 ± 7.41 days) and shortest (431.48 ± 9.95 days) calving interval are observed in winter and autumn season. Period of calving was non-significant on calving interval. Calving interval was longest in V-period.
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Table 3 Least Square Means ± SE value and effects of non-genetic factors on economic traits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>No.</th>
<th>LL (days)</th>
<th>No.</th>
<th>PDP (days)</th>
<th>No.</th>
<th>CI (days)</th>
<th>No.</th>
<th>MY/LL (kg)</th>
<th>No.</th>
<th>MY/CI (kg)</th>
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<td>439.03±5.49</td>
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<td>356</td>
<td>67.46±1.99</td>
<td>378</td>
<td>447.13±7.41</td>
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<td>13.01±0.03</td>
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<td>431</td>
<td>12.67±0.15</td>
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<tr>
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<td>205</td>
<td>66.42±2.38</td>
<td>219</td>
<td>440.06±8.86</td>
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<td>431.48±9.95</td>
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<td>I</td>
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<td>65.31±1.61</td>
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<td>65.74±2.55</td>
<td>153</td>
<td>423.93±9.64</td>
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<td>11.92±0.23</td>
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<td>4th</td>
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<td>69.11±3.40</td>
<td>87</td>
<td>434.06±12.82</td>
<td>153</td>
<td>13.98±0.23</td>
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<td>12.24±0.30</td>
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<td>5th</td>
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<td>69.10±4.58</td>
<td>50</td>
<td>425.65±16.94</td>
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<td>13.85±0.31</td>
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<td>91</td>
<td>12.99±0.31</td>
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<td>11.14±0.44</td>
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</table>

The values with different superscript within a column differs significantly 5% (*) and 1% (**)

(449.65 ± 11.49 days) and shortest in III-periods (425.33 ± 8.00 days). Parity influence the calving interval (P<0.01) as longest CI (472.08 ± 6.04 days) was seen in first lactation and minimum CI (423.93 ± 9.64 days) was in third lactation.

MY/LL: The overall least squares means of MY/LL was 12.93 ± 0.99 kg. Season of calving was significant on MY/LL (P<0.01). Autumn calvers showed maximum MY/LL (13.66 ± 0.18 kg) followed by winter calvers (13.01 ± 0.03 kg) while rainy season calvers showed minimum MY/LL (12.37 ± 0.16 kg). Period of calving was also influence on MY/LL (P<0.01). Cows in the fourth lactation showed highest MY/LL (13.98 ± 0.23 kg) followed by fifth lactation (13.85 ± 0.31 kg). The cows in first lactation revealed lowest MY/LL (10.85 ± 0.11 kg). Parity had significant influence on MY/LL (P<0.01).

MY/CI: Season of calving was significant influence on MY/CI (P<0.05). Higher MY/CI (11.59 ± 0.23 kg) was observed in autumn calvers whereas, lower MY/CI (10.86 ± 0.19 kg) was in summer calvers. Period of calving and parity had statistically significant influence on MY/CI (P<0.01). Cows in fourth lactation had highest average MY/CI followed by third lactation (12.24 ± 0.30, 11.92 ± 0.23 kg). The average MY/CI was lowest in first lactation cows (9.41 ± 0.14 kg). The overall least squares means of milk yield per calving interval in the present study was (11.08 ± 0.13 kg).

Discussion

Age at first calving

Age at first calving is an important economic trait. The early the cow matured the better is the profit. Overall least squares means for AFC in the present study was 1043.40 ± 6.64 days which were in agreement with Reddy and Basu (1985) and Rana (1991) in various crosses HF. however, in contrast to our findings Patil et al. (1980), Yadav and Balaine (1980), Arora (1986), Singh et al. (1988) and Rahman and Alemam (2008) reported lower average means of AFC in various HF crosses, while Duguma et al. reported higher average of AFC in HF cross with Zebu cow. Similar non-significant results of season of birth on AFC were also reported by Rana (1991) in HF crosses with SW/T and Singh (1995) in Karan Swiss and Karan Fries. While similar significant (P<0.01) period of birth on AFC was also reported by Nagaracenkar and Rao (1982), Singh et al. (1988) and Nayak and Raheja (1996) in various HF crosses. The shorter AFC (1035.94 ± 10.28 days) of cows born in winter season might be due to availability of good quality fodder and favourable climatic conditions which influence their growth. The variation in AFC observed during different periods might indicate the level of management as well as environmental effects. The level of management varies according to the ability of the farm manager, his efficiency in the supervision of the staff, system of crop husbandry, method and intensity of culling.

Service period

Service period is the interval from calving to the next conception. It has an economic importance because a longer service period increases the calving interval, resulting in a reduced life time production. Deshpande et al. (1988), Singh et al. (1990), Arora et al., (1995) reported similar means service
period (133.66 ± 3.89 days) in KF cow. However, higher average was given by Rahman and Alemam (2008) in HF and Zebu cross. Season has no statistical significant influence on service period. Similar findings were also reported by Su (1988) and Singh (1995) in Karan Swiss cattle and Singh et al. (1990) in HF crossbred. Cows calved during winter season has the longest service period (135.18±4.67 days) compared to autumn calvers (129.94±6.25 days) which have the shortest service period (Table 2). Service period was longest in V-period (148.40±7.33 days) while shortest was in I-period (123.15±7.02 days). Period of calving was significant (P<0.05) on service period. The variation of service period in different periods might be due to managemental problem, failure of heat detection and failure of A.I.

305 days milk yield

The lactation performance of dairy cattle is usually measured by determining total milk yield per lactation or per year, average daily milk yield, lactation length, persistency of milk production and milk composition. Performance of dairy animal is judged from the milk it produces during a specified period of lactation. Overall least squares mean for 305 DMY in the present study was (4113.61 ± 55.90 kg). Lower 305 DMY than present study was 4677.84 ± 50.35 kg (Table 1). Singh et al., (1981), Bhattacharya et al., (1993), Nayak and Raheja (1996) in HF crosses and Singh (1995) in KF reported lower TMY in HF and SW crosses in contrast to present finding. Season of calving was significant (P<0.01) on TMY supported by Parmar et al., (1986) in HF/Red Sindh cross with SW, Singh and Tomar (1991) in KF cattle and Raheja (1994) in HF cross with Hariana. Cows calved during autumn season produced maximum TMY (4894.80 ± 96.05 kg) followed by winter and summer calved cows (4798.72 ± 70.07) and (4592.83 ± 79.17) kg respectively. Those cows calved in rainy season shows the least TMY (4425.01 ± 82.511 kg). Cows might experience favourable climatic conditions and better availability of green fodder during autumn season. Period of calving and parity had significance (P<0.01) influence on TMY, in agreement with Rehman and Khan (2012) in Sahiwal cows. The variation of milk yield in different periods could be due to managemental differences and climatic fluctuation from year to year. The lower TMY in primiparous cows might be still growing and underdeveloped udder. The other reasons attributed to variation in milk yield from lactation to lactation in the same animal might be due to the physiology of lactation when a given set of genes interacts with non-genetic factors.

Lactation length

The present finding of average LL was 365.10 ± 3.34 days (Table 3), was higher than those reported by Gupta et al., (1986), Dalal et al. (1991), Nayak and Raheja (1996) and Rahman and Alemam (2008) in various HF crosses. Season of calving was statistically non-significant on lactation length while Gupta et al., (1986), Dalal et al. (1991) and Jadhav et al. (1991) reported significant effect of season on LL in different HF cross. It was also observed that period of calvingwas significant (P<0.01) on lactation length as reported by Gupta et al., (1986), Singh and Tomar (1990), Birader et al., (1993) and Nayak and Raheja (1996) in various HF cross. Cows in the first lactation showed maximum lactation length (391.23±3.70 days). Longer duration of lactation length in the primiparous cow might be due to prolong milking as long as they gave milk in order to judge their performance and potential and then removed from the herd when production is low.

Preceding dry period

The overall least squares mean of dry period (67.93 ± 2.12days) was similar with Singh and Tomar (1990) and Singh (1995) in HF cattle (Table 3). Higher average dry period was also reported by Rahman and Alemam (2008) in HF and Zebu crosses. Season of calving, period of calving and parity were all non-significant on preceding dry period. Singh and Tomar (1990), Singh et al. (1983) and Singh (1995) reported similar result in various crosses. The non-significant effect of parity on dry period was also reported by Rehman et al. (2008) in indigenous cattle. The dry period is a crucial stage in the lactation cycle of a dairy cow. One should aim to dry off...
pregnant cows to achieve a dry period of appropriate length to maximise productivity in the next lactation. This is a period of anatomical and physiological challenging time for the cow and her udder. It is a time of nutritional, metabolic and mammary change that will profoundly impact health and productivity in the next lactation.

Calving interval

Calving interval is the time between the two successive calving of a cow. Shorter calving interval is more preferable in the dairy herd as it reduces the costs of management and increases the lifetime production. Mean calving interval (439.03 ± 5.49 days) of present finding was slightly shorter than those reported by Rahman and Alemam (2008) in HF and Zebu cross. Season of calving was non-significant on calving interval. Winter calver showed maximum calving interval (447.13 ± 7.41 days), while autumn calvers (431.48 ± 9.95 days) showed minimum calving interval. Period of calving was not significant on calving interval. Calving interval was longest in V-period (449.65 ± 11.49 days) and minimum in III-periods (425.33 ± 8.00 days). The variation in the calving interval may be due to managerial and nutritional differences, seasonal effect of heat expression, accuracy of heat detection and efficiency of A.I. Parity had significant influence on calving interval (P<0.01). Those cows which were in the first lactation shows the longest calving interval of 472.08 ± 6.04 days, whereas cows in the third lactation revealed the minimum calving interval of 423.93 ± 9.64 days.

Milk yield per day of lactation length

It is a very important production efficiency trait, which is a combination of milk yield and lactation length. Cows with high milk yield per day of lactation length (MY/LL) are economic producers and have more lactation milk yield. Overall least square means of MY/LL was 12.93 ± 0.99 kg higher than those reported by Roy (1986) in HF and Zebu crossbreds. Season period and parity all of them had significant influence on MY/CI (P<0.05). Similar results are also reported by Butte and Deshpande (1987), Garcha et al. (1991) and Singh (1995) in various crossbreds. Those cows calved in the autumn season had the highest average MY/CI (11.59 ± 0.23 kg) whereas, cows calved during summer season had the lowest average MY/CI (10.86 ± 0.19 kg). The variation in average MY/CI in different seasons indicates the effect of season and management in Karan Fries cows. Cows calved during the IV-period had the highest MY/CI followed III, V and II period (11.97 ± 0.18, 11.54 ± 0.19, 11.20 ± 0.27 and 10.64 ± 021 kg) respectively. Cows in fourth lactation (12.24 ± 0.30) had the highest average MY/CI followed by third lactation (11.92 ± 0.23 kg). The average MY/CI was lowest in first lactation cows (9.41 ± 0.14 kg). The reason might be same as stated in the earlier traits.

Conclusions

The study indicates that environmental factors like season, period and parity has proved to be significantly influencing on most of the economic traits. The production and reproductive performances of Karan Fries crossbred cows can be improved by improving the managerial practices and proper feeding of animal in adverse climatic conditions. Therefore, additional production strategies like improving environmental factors and proper management of cows are needed to counteract the adverse effect of seasonal and periodical changes.

References

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