Disposal Pattern and Its Impact on Milk Production and Herd Size in Karan Fries and Karan Swiss Cows

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ABSTRACT : Data on 958 Karan Fries (KF) and 780 Karan Swiss (KS) cows, born during 1974 to 1992 at National Dairy Research Institute, Karnal were evaluated for causes of culling and their impact on milk performance and herd strength. Causes of culling were classified as voluntary culling (low milk yield) and involuntary culling (other than milk yield). The milk yield of cows was evaluated in-retrospectively by estimating expected breeding value (EBV) on the basis of first lactation yield (FLY) and all available lactation yield (ALY). The culling rate of KF cows over the years varied from 10.89 (1988) to 33.92% (1991) with an overall average of 20.96% and in KS from 19.91 (1984) to 33.74% (1989) with an overall average of 25.01%. Reproductive disorders, teat and udder problems, low milk production, health and locomotive disorders were the major reasons of culling accounted respectively for 5.56, 4.97, 4.61, 3.18 and 2.24% of herd strength in KF cows. The corresponding causes of culling were 6.20, 6.26, 7.69, 1.49 and 2.67% of herd strength in KS cows. The involuntary culling of cows accounted for 82.4% in K F and 76.1% in KS cows of total culling. The average annual disposal rate in KF and KS was 26 and 30% whereas annual replacement rate was 24 and 26% respectively. The EBV of involuntary culled cows on the basis of FLY and ALY was 3,111 and 3,515 kg in KF; and 2,669 and 2,940 kg in KS cows respectively. The EBV of selected cows on the basis of FLY and ALY was 3,242 and 3,549 kg in KF and 2,893 and 3,245 kg in KS cows respectively. The average breeding value of involuntary culled cows was not significantly different from selected cows in both the herds. The high rate of involuntary culling of potential cows might be major factor responsible for declined performance and size in these herds. The results indicated that higher genetic gain (2.14% of herd average in KF and 3.49% of herd average in KS) could be obtained by restricting the involuntary culling (50% of total culling) through improved management practices and increasing replacement rate. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 9 : 1214-1218)***

Key Words : Culling, Voluntary, Involuntary, Karan Fries and Karan Swiss

INTRODUCTION

Culling of inferior-stock is a routine managemental exercise to facilitate the entry of replacement heifers for improving the herd performance. In principal a cow should be culled regardless of her age, if heifer to out-perform her. Removal of less productive animals from the herd is likely to bring about genetic improvement but its higher rate due to reasons other than milk production might decreases genetic improvement by reducing the selection intensity.

A nucleus herds of Karan Fries (KF) and Karan Swiss (KS) was set up at NDRI, Karnal to meet the demands of high yielding crossbred bulls suitable for Indian tropical climates (Singh and Gurnani, 2004). These herds have shown declining trend with respect to performance and herd size. High rate of involuntary culling may be having negative effect on the performance because such type of culled cows may possess high potential for production. Therefore, it becomes necessary to examine the factors which may be have negative effect on selection for milk yield and to workout the possible levels of selection intensity for males to neutralize the adverse selection pressure of involuntary female selection. Moreover, if the culling rate of females from time to time is larger then replacement rate than there would be a gradual reduction in herd size. Therefore, in order to maintain the herd size it would be necessary to lay down the optimum culling levels at different ages of the females to keep herd size constant and to maximize the genetic progress and economic viability of the dairy herds. Few reports are available on impact of disposal pattern on milk performance of cows. Present study therefore, not only delineate the reasons of disposal but also assessed its effect on performance and herd size.

MATERIALS AND METHODS

Present investigation was carried out with Karan Fries (KF) and Karan Swiss (KS) cows maintained at National Dairy Research Institute Karnal, Haryana, situated in trans-gangetic plain region. These strains were developed by crossbreeding and subsequently inter-se-mating of Tharparkar and Sahiwal cows with Holstein Friesian and Brown Swiss bulls respectively (Singh and Gurnani, 2004). The nutritional requirements are met through a balanced ration made up of green fodder, dry fodder and concentrate. The calves are weaned at birth and upto 5thday of birth the calves are fed colostrum of it's dam and later on whole milk

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Table 1. Culling rate due to different reasons in Karan Fries (KF) and Karan Swiss (KS) cows

Year of culling	Number of cows available in the herd		Low milk production		Reproductive problems		Teat & udder problems		Health problem		Locomotive problems		Others		Overall culling rate	
	KF	KS	KF	KS	KF	KS	KF	KS	KF	KS	KF	KS	KF	KS	KF	KS
1982	278	234	-	-	-	-	-	-	-	-	-		-		19.06	22.64
1983	277	229	-		-	-	-	-	-	-	-		-		17.69	22.27
1984	284	231	4.23	8.66	7.75	4.77	3.17	3.89	3.87	0.86	2.11	1.30	1.05	1.29	22.18	19.91
1985	277	237	4.69	6.75	6.86	2.53	6.14	5.48	3.61	1.68	2.89	2.95	2.89	2.10	25.27	21.94
1986	246	227	4.88	8.37	5.69	5.29	4.06	8.37	2.44	1.32	4.06	3.37	1.62	1.74	21.13	29.07
1987	236	209	3.39	7.65	2.54	6.22	2.97	4.78	2.97	1.91	1.69	2.87	2.11	2.39	14.40	24.88
1988	248	182	3.22	4.94	2.42	7.14	1.61	5.49	2.41	1.09	2.41	1.64	0.40	0.00	10.89	20.32
1989	259	163	7.72	12.26	6.95	8.58	2.70	7.36	1.54	2.45	1.54	3.06	0.40	0.00	20.84	33.74
1990	242	136	5.79	8.08	7.43	10.29	5.79	4.41	4.54	2.20	1.65	4.41	2.07	0.73	27.27	30.14
1991	224	117	3.57	6.84	6.25	8.54	11.16	10.25	4.91	0.90	3.57	3.71	4.46	1.70	33.92	31.62
1992	216	110	3.70	4.54	3.24	5.45	8.34	9.09	2.31	0.91	0.00	0.91	0.00	2.87	18.52	26.36
Overall	2,787	2,075	4.61	7.69	5.56	6.20	4.97	6.26	3.18	1.49	2.24	2.67	1.74	2.11	20.96	25.01

* Specific reasons of culling during 1982 and 1983 were not available.

upto 30 days. At later ages feeding schedules are laid down according to age considering the requirements for maintenance, growth, reproduction and production. Green fodders are provided *ad libitum* to heifers and cows. All the animals are stall-fed. Growing females, heifers and cows of different categories (pregnant, dry, lactating etc.) are kept in separate groups in different paddocks with sheds under loose housing system. Cows were milked thrice a day. High yielding cows were machine milked and comparatively low yielders by hand. Females are being evaluated on the basis of their own performance (AHC, milk yield) and males on the basis of their growth, sibs and progeny performance. Karan Fries and Karan Swiss cows presently have 62.5 and 50% level of exotic inheritance.

The data were collected on 958 KF and 780 KS cows spread over 11 years (1982 to 1992) and born during 1974 to 1992. Data on disposal were collected from biannual auction lists and other stock registers. The surplus and non-desirable cows in both the strains were disposed off every year in March and September on the basis of (i) milk yield (ii) reproductive disorders (iii) teat and udder disorders and (iv) locomotive disorders. The milk yield and other associated information were recorded from history sheet registers. Calving interval affected by abnormal calving were excluded for present study however milk yield of lactations which completed their full duration to the day of natural drying (after 100 days) were included based on the fact that cows retained physiological function with normal lactation process. Chi-square (x^2) analysis was used to find out the significance of difference in estimates over the years. The heritability (h^2) was estimated by paternal half sib correlation method on data adjusted for non-genetic factors using following model (Becker, 1975).

$$Y_{ij}=\mu+s_i+e_{ij}$$

Where,

Y_{ij}=record of j^{th} daughter of i^{th} sire.

μ=Population mean; S_i=Effect of i_{th} sire (I=1, 2, ...S); S=Number of sire

e_{ij}=Random error with mean 0 and variance $\sigma^2 e$

Repeatability was estimated as intraclass correlation using the records of same animals in successive lactations. Cows with minimum 2 lactation records were included in the study. Average expected breeding value was estimated on the basis of first lactation yield 305 days (EBV-F) for all cows available in the herd, voluntary, involuntary culled, selected and the cows which entered the herd in that specific year. Similarly, the EBV for above-mentioned categories of cows was estimated in-retrospect (EBV-A) on the basis of all available lactations yield (at least with 2 records). This was done separately for each year to get information on possible reasons for change in performance of cows in different years. The EBV was estimated using following formula:

$$EBV=\mu+\frac{nh^2}{1+(n-1)r}(X-\mu)$$

Where, μ=Herd average, n=Number of lactation milk records, h^2=Heritability of milk yield (KF=0.41; KS=0.49, r=Repeatability of lactation milk yield, (KF=0.50; KS=0.58, X=Cows average performance.

RESULT AND DISCUSSION

Reasons of culling in cows over years

Culling rate due to various reasons over the years in KF and KS cows are presented in Table 1. Culling rate in KF

Table 2. Changes in selection differential for expected breeding value of Karan Fries cows

Years	EBV of cows in the herd		EBV of involuntary culled cows		EBV of Voluntary culled cows		EBV of disposed cows		EBV of selected cows		Selection differential		EBV of cows entered	
	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L
1982	3.347 (278)	3.659	-	-	-	-	3.079 (68)	3.079	3.433 (210)	3.433	86	86	3.112 (69)	3.112
1983	3.353 (277)	3.589	-	-	-	-	3.176 (64)	3.176	3.391 (213)	3.391	38	38	3.172 (67)	3.172
1984	3.309 (284)	3,564	3.215 (62)	3,574	2.445 (12)	2.445	3,091 (74)	3.091	3.386 (210)	3,386	77	77	3.147 (71)	3,147
1985	3.182 (277)	3,630	3.095 (80)	3,716	2.286 (13)	2.286	2,982 (93)	2.982	3.267 (184)	3,267	85	85	3.217 (67)	3,217
1986	3.145 (246)	3,581	3.182 (52)	3,642	2.182 (12)	2.182	2,996 (64)	2.996	3.197 (182)	3,197	52	52	3.096 (62)	3,096
1987	3.174 (236)	3,660	3.207 (42)	3,802	2.356 (8)	2.356	3,072 (50)	3.072	3.201 (186)	3,201	27	27	3.078 (54)	3,078
1988	3.166 (248)	3,559	3,117 (32)	3,686	2,119 (8)	2,119	2,917 (40)	2.917	3.214 (208)	3,214	48	48	3.159 (62)	3,159
1989	3.001 (259)	3,342	3.006 (41)	3,207	1.978 (20)	1.978	2,669 (61)	2.669	3.104 (198)	3,104	103	103	3.104 (51)	3,104
1990	3.083 (242)	3.303	3.107 (57)	3.344	2.078 (14)	2.078	2.904 (71)	2.904	3.157 (171)	3.157	74	74	3.204 (44)	3.204
1991	3.033 (224)	3.286	3.017 (80)	3.312	2.111 (8)	2.111	2.935 (88)	2.935	3.096 (136)	3.096	63	63	3.059 (53)	3.059
1992	3.072 (216)	3.261	3.081 (44)	3.415	1.904 (8)	1.904	2.899 (52)	2.899	3.127 (164)	3.127	55	55	3.158 (80)	3.158
Overall	3.175	3.503	3.111 (490)	3.515	2.147 (103)	2.147	2.982 (725)	2.982	3.242 (2.062)	3.242	64	64	3.139 (680)	3.139

Values in parenthesis are number of observations and numbers are same for first (F-L) and all lactations (A-L).

Table 3. Changes in selection differential for expected breeding value of Karan Swiss cows

Years	EBV of cows in the herd		EBV of involuntary culled cows		EBV of Voluntary culled cows		EBV of Voluntary culled cows		EBV of Voluntary culled cows		Selection differentia		EBV of cows entered	
	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L	F-L	A-L
1982	2.818 (234)	3.370	-		-		2.673 (69)	3.276	2.878 (165)	3.409	60	39	2.712 (74)	3.202
1983	2.826 (229)	3.239	-		-		2.598 (64)	2.958	2.914 (165)	3.348	88	109	2.866 (64)	3.178
1984	2.874 (231)	3.183	2.904 (34)	3.157	2,213 (20)	2.413	2,649 (54)	2.880	2,943 (177)	3,276	69	93	2.920 (66)	3,179
1985	2.859 (237)	3.070	2.707 (45)	2.953	1.981 (16)	2.316	2.516 (61)	2.786	2.978 (176)	3.168	119	98	2.821 (60)	3.198
1986	2.738 (227)	3.132	2.702 (56)	3.040	1.884 (19)	2.178	2.498 (75)	2.821	2.856 (152)	3.286	118	154	2.736 (51)	3.216
1987	2.692 (209)	3.109	2.571 (48)	2.958	1,978 (16)	2.056	2,423 (64)	2.732	2,786 (145)	3,278	94	169	2.729 (57)	3,159
1988	2.752 (182)	3.062	2.512 (44)	2.876	2,013 (9)	2.076	2.427 (53)	2.740	2,874 (129)	3,194	112	131	2.757 (37)	3,159
1989	2.740 (163)	3.014	2.744 (45)	2.907	1.945 (20)	2.078	2.498 (65)	2.663	2.894 (98)	3.246	154	232	2.812 (34)	3.209
1990	2.679 (136)	3.028	2.603 (38)	2.972	1.857 (11)	1.968	2.436 (49)	2.746	2.816 (87)	3.186	137	158	2.756 (38)	3.274
1991	2,718 (117)	2.880	2.613 (34)	2.679	2.112 (8)	2.213	2,518 (42)	2.590	2,893 (75)	3,042	175	162	2.906 (30)	3,091
1992	2.857 (110)	2.915	2.704 (29)	2.849	2.068 (5)	2.176	2.610 (34)	2.745	2.968 (76)	2.991	111	76	2.912 (35)	2.934
Overall	2.783 (2.075)	3.119	2.669 (373)	2.940	2.001 (124)	2.179	2.531 (630)	2.829	2.893 (1.445)	3.245	112	129	2.807 (546)	

Values in parenthesis are number of observations and numbers are same for first (F-L) and all lactations (A-L).

cows varied from 10.89 (1988) to 33.92% (1991) with an overall average of 20.95%. and in KS cows from 19.91 (1984) to 33.74% (1989) with an overall average of 25.01%. The present findings were in agreement with the reports of Taneja and Bhatnagar (1987) and Kulkarni and Sethi (1990) in crossbred. Allaire et al. (1977), Esslemon (1992) and Crosse and Donovan (1989) in Friesian cows and Chhikara and Balaine (1977) in zebu cows.

The reproductive disorders in KF cows were the principal reasons of culling accounting 5.56% of herd strength. The other majors reasons were teat and udder problems, low milk yield, health disorders and locomotive disorders accounting for 4.97, 4.61, 3.18 and 2.24% of herd strength, respectively. Whereas low milk yield in KS herd was the principal reason of culling accounted for 7.69% of herd strength. Disorder of teat and udder, reproduction, foot and leg and health were accounted for 6.26, 6.20, 2.67 and 1.45% culling, respectively. Higher voluntary culling rates were reported by Kulkarni and Sethi (1990), Milian and Smith (1989) and Reddy and Nagarcenkar (1989). Whereas Allaire et al. (1977) Taneja et al. (1989) and Jadhav et al. (1995) reported higher culling due to reproductive disorders, udder disorders and health disorders. Singh and Gurnani (2003) also reported infertility, health and udder problems as major causes of culling in crossbred heifers. In these herds Pneumonia, Enteritis, Tuberculosis, Foot and Mouth, and Toxemia, etc. were the major causes of poor health. Lin and Aggery (2003) reported that low production and reproductive disorders caused by sub clinical infections are misclassified as the reasons of culling when disease problems infect is the main culprit and should be identified as the reasons of disposal. Moreover, diseases also impair the reproductive disorders. The FMD, foot problems and lameness were the major causes of culling on locomotive problems in these herds. The other miscellaneous reasons of culling were old age, self-sucking, accident etc. accounted for 1.87 and 2.11%, respectively in KF and KS herds.

Impact of disposal on milk production performance

The average EBV-F varied from 3.001 kg (1989) to 3.353 kg (1983) with an overall average of 3,177 kg in Karan Fries cows. The EBV-A varied from 3,261 kg (1992)

Table 4. Effect of culling pattern on milk yield (FLY-305 d) in Karan Fries and Karan Swiss cattle

Involuntary culling (%)	Voluntary culling (%)	Selection Intensity	Genetic gain/generation	Herd Average
Karan Fries cattle				
0	24	0.409	137.51	4.36
5	19	0.336	112.96	3.57
10	14	0.258	86.74	2.74
12	12	0.227	76.32	2.41
15	9	0.175	58.84	1.85
20	4	0.089	29.92	0.94
22	2	0.049	16.47	0.52
Karan Swiss cattle				
0	26	0.438	178.56	6.24
5	21	0.365	148.80	5.20
10	16	0.289	117.82	4.12
12	13	0.244	99.47	3.49
15	11	0.212	86.43	3.01
20	6	0.135	55.04	1.92
22	3	0.069	28.12	0.98

Annual disposal rate=24 and 26% of herd strength.
h^2 of FLY-305 days=0.41and 0.49.
Phenotypic SD (ΔP)=820 kg and 832 kg.
Herd average=3,165 kg and 2,860 kg.

to 3,659 kg (1982) with an overall average of 3,504 kg (Table 2). Whereas, in Karan Swiss cows the EBV-F varied from 2,679 kg (1990) to 2,874 kg (1984) with an overall average of 2,783 kg and the EBV-A varied from 2,880 kg (1991) to 3,370 kg (1982) with an overall average of 3,119 kg (Table 3). The lower breeding value in-retrospect during 1991 and 1992 may be attributed to incorporation of less number of lactations (i.e. 2) in analysis. The cows culled on involuntary reasons did not significantly differ from those cows (breeding value) retained in the herd or selected over the years (Tables 2 and 3). The overall weighted selection differential (EBV-F and EBV-A) was 64 and 43 kg in KF herd. The corresponding estimates in KS cows were 112 and 129 kg, respectively. The weighted average EBV of selected cows was higher than that of disposed animals. These results showed that effective culling resulted in improvement. However overall results indicated that individual selection of cows resulted in very small improvement of herd. This might be due to high incidence of involuntary culling (82% in KF and 76% in KS) which could lead to negative selection by limiting culling on milk performance. Moreover some cows, which were disposed off through involuntary culling were of very high transmitting ability. Higher incidences of diseases, udder edema and culling were also reported by Erb and Martin (1980), Shanks et al. (1999) and Lund et al. (1999) in high yielding cows. The weighted average EBV of KF and KS cows that entered the herd was almost equal as compared to cows, which were in the herd (Tables 2 and 3). Further, majority of cows which were in the herd in various years were selected whereas the heifers entered the herd in different years were not selected. The average EBV-A also showed similar pattern. The perusal of Tables 2 and 3 further indicated that high rate of involuntary culling was one of major factor responsible for inconsistent performance by reducing the selection intensity. The present results were in agreement with those reported by Kulkarni and Sethi (1990) and Beaudean et al. (1993).

Impact of disposal on changes in herd size

Herd size of breedable Karan Fries cows declined from 278 in 1982 to 216 in 1992.The females born fluctuated from 138 (1985) to 87 (1990) with an average of 112 per year. The decline in herd size occurred mainly due to higher average annual disposal rate of 26% than the replacement rate of 24.40%. Similar trend was obtained in Karan Swiss herd, where the annual replacement rate was 26.31% and the disposal rate was 30.36%. The mortality rate accounted for nearly 6% herd strength in both herds. The reproductive efficiency was 84 and 81% in Karan Fries and Karan Swiss cows, respectively. Therefore, it is necessary to take suitable measures like better feeding, management, disease control, etc. to keep the disposal below replacement rate. These measures will provide more selection intensity leading to higher genetic gain from the path dam to produce daughters. This is evident from the results on expected selection intensity and expected genetic gain for milk production given in Table 4. The results on culling indicate that as the voluntary culling rate increased the expected genetic gain also increased. The expected genetic gain would be 76.32 and 99.47 kg/generation at 12-13% of voluntary culling (50% of total culling) in KF and KS, respectively.

The above results revealed that the high rate of involuntary culling among adults cows might be attributed for declined milk yield due to diffusion of superior cows and reduction in herd size by lowering the replacement rates. The regular intensive examination of animals particularly udder and teat, genital tract and for general disease substantially reduce the "involuntary" culling. The intensive health care is likely to increase the cost of health management, but the returns in terms of higher production and genetic improvement are expected to compensate for such cost. Nutritional status and feeding schedule need to be critically reviewed and vaccination, medication and general environmental conditions need to be improved. Recently available molecular genetic technology like marker-assisted selection along with conventional methods might be useful to enhance disease resistance in these animals.

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