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Economic Analysis of Culling in Vrindavani Cows

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ABSTRACT

Culling is an act of identifying and removing a cow from a herd assuming a constant or expanding herd size, replacing the cow with another cow often with a first-lactation heifer. The relevant data was collected based on the observations from the study on female Vrindavani cattle reared at Cattle and Buffalo Farm of Livestock Production and Management, Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh. The data was collected for 10 years (1999-2000 to 2009-10). The year wise means for average lactation milk yields (pooled over all lactations) in Vrindavani, selected and culled cows were estimated and used for estimating selection differential (P_s – P), deviation of culled cows (P_c) from herd average (P) and difference between the means of selected cows (Ps) and the means for culled cows (Pc) were studied. The means for P, P_s and P_c for average per lactation milk yield up to disposal (AVMYL) of Vrindavani ranged from 1470.18 (2000) to 2879.18 kg (2009), 2175.45 (2000) to 3589.47 kg (2007) and 1385.15 (2000) to 2388.34 kg (2008). It has been observed that the range for selection differential (P_s-P) varied from 460.27 (1999) to 1364.38 kg (2007). However, ranges for deviations of culled Vrindavani cows mean from herd average (P – P_c) and from that of selected group (P_s – P_c) ranged from 21.45 (2001) to 491.46 kg (2004) and 522.26 (1999) to 1541.47 kg. The age at completion of first lactation was estimated by adding average age at first calving (AFC) to average first lactation length (TLL1). The age at completion of first lactation and per day milk yield varied from 1177.71 (2000) to 1328.92 d (2007) and 8.15 (1999) to 12.48 kg/d (2004). The range for period in between point of AFC and 24 months of age varied 213.63 (2000) to 307.89 d (2004). The rearing cost of Vrindavani first calvers (up to completion of first lactation) varied from Rs. 69944.42 (2000) to Rs. 79570.22 (2009).

Keywords: Dairy, Vrindavani, Parity, Culling, AFC, Management, Culling differential

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INTRODUCTION

The environmental conditions of tropics are harsh and is also synergized with dairy animals' low genetic potential, low prolificacy, frequent occurrence of diseases, severe infestation of insects and pests etc. leading to poor production among majority of our native livestock breeds. Low purchasing power, small land holding sizes, poor managemental practices adopted by unaware and uneducated livestock dairy farmers are another grave area of concern. Observing the gravity of problems faced by livestock sector, our prime need is to adopt scientific management practices to bridge the mismatch between fodder and livestock.

Crossbred populations were developed by galvanizing several populations/breeds of different characteristics to enhance milk production (in f_1), possibly due to heterosis (Nagarcenkar *et al.*, 1980), when continued, resulted in loss of heterosis in f_2 and further generations along with increased variability as compared to that present in constituent populations (Lopez, 1974). Selection is, therefore, practiced to bring improvement and stability into these crossbred populations. The selection of parents, for future generations, results in culling of their low producing undesirable counterparts. Hence, selection and culling are complimentary to each other. Propagation of highly productive animals through selective breeding and culling of uneconomic poor yielding counterparts may efficiently reduce the gap of fodder requirement of our livestock at national level, in addition to, achieving the targets and objectives of research and animal improvement programs. Revenue generated from sale of culled animals will not only solve the problems of animal rearers, but will also assist in accumulation of huge finances in

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the shape of government funds which could be used to help and address the nutritional emergency of the people of our poor nation.

Culling is an act of identifying and removing a cow from a herd assuming a constant or expanding herd size, replacing the cow with another cow often with a first-lactation heifer. Cows sold for dairy purposes are also termed as culled indicating that separating off cow from herds either desirably or undesirably, which is efficient or inefficient or uneconomical for a producer (Fetrow *et al.*, 2006). Several criteria have been utilized to evaluate culling for the dairy cow. To enhance the productivity and efficiency in dairy cattle and buffaloes, there is a need to adopt scientific culling. Culling is one of the novel techniques through which productivity and economics of a dairy farm may be improved in a dynamic way. The decision to cull a cow is complicated with many factors influencing that decision, notably age (parity), milk production, fertility and health (Grohn *et al.*,1998, Ahlman *et al.* 2011). Culling may either be voluntary or involuntary. Voluntary culling occurs when the dairy farmer chooses to remove a healthy and fertile cow due to poor milk production. On the other hand, involuntary culling occurs when the dairy farmer is forced to remove a productive, profitable cow due to illness, injury, infertility, death etc. Voluntary culling is the removal of animals of those lots that does not fall under certain defined parameters like low milk yield, conception, lactation length, disease resistance *etc.* fixed under the decision horizon of the entrepreneur of a dairy farm.

Timely culling of undesirable animals is the most essential phenomenon through which sustainability of the dairy livestock business could be achieved by reducing the burden of low yielders and prohibiting the propagation of inferior genes in the population (Jones, 2001). Keeping in view, the above facts pertaining to culling and its impact on livestock productivity, continuity of livestock farm including business profitability, the present study was planned on Vrindavani cows with the objective to study the impact of culling on performance in Vrindavani cows.

MATERIALS AND METHODS

The relevant data was collected based on the observations from the study on female Vrindavani cattle reared at Cattle and Buffalo Farm of Livestock Production and Management, Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly, Uttar Pradesh. The data was collected for 10 years (1999-2000 to 2009-10).

The information for each animal was collected from individual cow history sheets and other relevant registers. In order to assess the impact of culling on performance of Vrindavani cows all the available cows during a particular year were divided into separate distinct groups i.e. replacement heifers (RH) completing their first lactation during that particular year, females culled (Pc), females selected (Ps) during that year and total herd (P) available during the year. The milk yield expressed by each distinct group during a particular year as well as during each year of study was calculated. The selection differential due to selection and culling of animals was estimated as follows:

Selection Differential (SD = PFS – $\bar{P}$

Culling Differential (CD = PFC – $\bar{P}$

Where, PFS : Mean of selected females

PFC : Mean of females culled

$\bar{P}$: Population mean

The impact was assessed by multiplying these differences with the actual unit rate of milk. At the same time, the costs involved in rearing these animals' up to different stages (Table1) was subtracted from this value to assess the net value of replacement stock/heifer. The rearing cost of females was estimated as per Shukla (2005).

RESULTS AND DISCUSSION

The year wise means for average lactation milk yields (pooled over all lactations) in Vrindavani, selected and culled cows were estimated and used for estimating selection differential (P_s – P), deviation of culled cows (P_c) from herd average (P)

Table 1: Total rearing cost calculation for Vrindavani heifers

Particulars	Periods				
	0-3 m	3-6 m	6-12 m	12-18 m	18-24 m
Total LBW gain (kg)	23.78	37.66	61.94	71.71	59.27
LBW gain/d (kg)	0.26	0.42	0.34	0.40	0.33
PDDMR (kg)	-	1.61	2.86	4.53	6.17
Concentrate Allowance /d (kg)	-	1.00	2.00	2.00	2.00
DM to be given th GF (kg)	-	0.61	0.86	2.53	4.17
PDGFR (kg)	-	3.41	4.77	14.05	23.15
Total feeding cost in Rs. (Cost of conc. + cost of green fodder - TFC)	5797.00	1963.75	7117.50	10458.75	13733.25
TFC /d (Rs.)	64.41	21.82	39.54	58.10	76.30
Miscellaneous cost in Rs. (Labour, medicine etc. - 30% of the TFC)	2484.43	841.61	3050.36	4482.32	5885.68
Total cost	8345.84	2827.18	10207.40	14999.18	19695.22
Total cost/d (Rs.)	92.73	31.41	56.71	83.33	109.42

Table 2: Impact of culling on average lactation milk yield of Vrindavani cows

Year	Herd average (P)	Average of selected cows (Ps)	Average of culled cows (Pc)	Differentials		
				Ps-P	Ps-Pc	P-Pc
1999	1796.86	2257.13	1734.87	460.27	522.26	61.99
2000	1470.18	2175.45	1385.15	705.27	790.30	85.03
2001	1654.24	2449.44	1632.79	795.20	816.65	21.45
2002	1950.92	3140.11	1882.26	1189.19	1257.85	68.66
2003	1867.13	3208.11	1745.60	1340.98	1462.51	121.53
2004	2016.38	3066.39	1524.92	1050.01	1541.47	491.46
2005	2023.34	3135.42	1938.00	1112.08	1197.42	85.34
2006	2225.01	3537.73	2177.57	1312.72	1360.16	47.44
2007	2225.09	3589.47	2170.88	1364.38	1418.59	54.21
2008	2524.62	3581.59	2388.34	1056.97	1193.25	136.28
2009	2879.18	3566.54	2764.91	687.36	801.63	114.27

and difference between the means of selected cows (Ps) and the means for culled cows (Pc) are presented in Table 2. The means for P, P_s and P_c for average per lactation milk yield up to disposal (AVMYL) of Vrindavani ranged from 1470.18 (2000) to 2879.18 kg (2009), 2175.45 (2000) to 3589.47 kg (2007) and 1385.15 (2000) to 2388.34 kg (2008). Most of these traits expressed a gradual desirable improvement over years (Table 2). It has been observed that the range for selection differential (P_s- P) varied from 460.27 (1999) to 1364.38 kg (2007). However, ranges for deviations of culled Vrindavani cows mean from herd average (P – P_c) and from that of selected group (P_s – P_c) ranged from 21.45 (2001) to 491.46 kg (2004) and 522.26 (1999) to 1541.47 kg (2004, Table 2). It clearly indicated that the average lactation milk yield of culled Vrindavani cows was considerably lower as compared to that of selected cow group as well as herd averages which ultimately brought genetic improvement in the Vrindavani cattle herd as reflected by total lactation milk yields in various lactations of Vrindavani cows as well as genetic trends expressed by TLMY1 of Vrindavani cattle (Table 2).

The impact of culling as reflected through improved TLMY1 of Vrindavani first calvers completing their lactation in the herd was estimated based on superiority obtained through selection differential (Ps – P) and adding it to the TLMY1 of the herd (parental generation). Allairwe and Cunnigham (1980) found the intensity of voluntary culling be at most 3-8 % in addition to involuntary culling to maximize milk yield, whereas Allaire (1981) indicated that with 20 % involuntary culling, milk yield was increased by additional 10-15 % of voluntary culling. Kulkarni and Sethi (1990) during their study on Karan Fries and Karan Swiss cows during the periods 1976-84 reported annual culling rates due to various reasons as 18-24 % respectively. However, they could not find consistent trend in milk production throughout the period either due to replaced animal or culled animals. Overall, they observed 6.09 % average annual increase in milk production of Karan Swiss and 0.05 % in Karan Fries for the same period.

For estimating the rearing cost of first calvers completing their

Table 3: Impact of culling – profitability analysis in Vrindavani cows

YOD	TLMY1	Herd ave. (P)	Culled ave. (Pc)	Selected ave. (Ps)	Ps-P	Pc-P	Mean 1st lactation (Ps_1) (Ps1=TLMY1+(Ps-P)	Mean AFC	Mean TLL1
1999	1796.65	1796.86	1734.87	2257.13	460.27	-61.99	2256.92	962.63	276.99
2000	1456.33	1470.18	1385.15	2175.45	705.27	-85.03	2161.60	943.63	234.08
2001	1627.91	1654.24	1632.79	2449.44	795.20	-21.45	2423.11	958.43	260.83
2002	1714.83	1950.92	1882.26	3140.11	1189.19	-68.66	2904.02	949.62	264.41
2003	1643.12	1867.13	1745.60	3208.11	1340.98	-121.53	2984.10	951.60	265.77
2004	1986.59	2016.38	1524.92	3066.39	1050.01	-491.46	3036.60	1037.89	243.26
2005	1982.92	2023.34	1938.00	3135.42	1112.08	-85.34	3095.00	1019.58	285.02
2006	1989.46	2225.01	2177.57	3537.73	1312.72	-47.44	3302.18	1006.48	282.13
2007	2193.77	2225.09	2170.88	3589.47	1364.38	-54.21	3558.15	1035.12	293.80
2008	2435.52	2524.62	2388.34	3581.59	1056.97	-136.28	3492.49	980.04	294.74
2009	3078.54	2879.18	2764.91	3566.54	687.36	-114.27	3765.90	987.50	319.12

Table 4: Impact of culling – profitability analysis in Vrindavani cows (continued)

YOD	Age (at completion of 1st lactation)	PDMY (kg)	AFC-24 m	Cost up to AFC	Rearing cost in Rs. (up to completion of 1st lactation)	Value of milk of selected 1st lactation cows	Profit/loss – over rearing cost (Rs.)
1999	1239.62	8.15	232.63	56974.82	70516.34	49652.24	-20864.10
2000	1177.71	9.23	213.63	56974.82	69944.42	47555.20	-22389.22
2001	1219.26	9.29	228.43	56974.82	71513.48	53308.42	-18205.06
2002	1214.03	10.98	219.62	56974.82	74398.94	63888.44	-10510.50
2003	1217.37	11.23	221.60	56974.82	74879.42	65650.20	-9229.22
2004	1281.15	12.48	307.89	56974.82	75194.42	66805.20	-8389.22
2005	1304.60	10.86	289.58	56974.82	75544.82	68090.00	-7454.82
2006	1288.61	11.70	276.48	56974.82	76787.90	72647.96	-4139.94
2007	1328.92	12.11	305.12	56974.82	78323.72	78279.30	-44.42
2008	1274.78	11.85	250.04	56974.82	77929.76	76834.78	-1094.98
2009	1306.62	11.80	257.50	56974.82	79570.22	82849.80	3279.58

first lactation in the herd, the per day rearing costs estimated for 18-24 m in Table 1 was assumed to be similar up to end of first lactation. Additional cost of 1 kg concentrate as pregnancy allowance for last two months of advance pregnancy was also added to the base cost of first calvers completing first lactation. Bauer *et al.* (1993) estimated that changes in replacement heifer prices or a large decrease in cull cow prices should have large effects on the optimal terminal lactation for Alberta producers.

The age at completion of first lactation was estimated by adding average age at first calving (AFC) to average first lactation length (TLL1). Additional concentrate cost incurred on milk allowance was calculated at the rate of one kg concentrate over 2.5 kg milk production. The average milk production per day was estimated by dividing TLMY1 (of selected first calvers) by average TLL1 and appropriate concentrate allowance was allocated to it i.e. to the base cost. At the same time, the value of milk of selected first calvers was estimated by multiplying the average TLMY1 of selected first calvers with the prevailing rate of milk i.e. @ Rs. 22/- per kg in case of Vrindavani cattle.

Ultimately, the impact of culling was quantified by subtracting rearing cost of selected first calvers (up to completion of first lactation) from the value realized through sale of milk of selected first calvers (completing first lactation) and was termed as profit/loss in rearing these selected heifers up to completion of first lactation – over rearing costs incurred on these first calvers (up to completion of first lactation). Renkema and Stelwagen (1979) found that cull cow prices had a small effect on optimal culling policies for Dutch herds. Rogers *et al.* (1988) showed that replacement heifer prices had a large effect on culling decisions for US dairy farm managers.

The observed range for TLMY1 in the herd was 1456.33 (2000) to 3078.54 kg (2009). At the same time, the ranges for herd average (P, pooled over all lactations), average of culled cows (P_c) and average of selected cows (Ps) varied from 1470.18 (2000) to 2879.18 kg (2009), 1385.15 (2000) to 2764.91 kg (2009) and 2175.45 (2000) to 3589.47 kg (2007, Table 2). The ranges for (P_s – P) and (P_c – P) varied from 460.27 (1999) to 1364.38 kg (2007) and – 491.46 (2004) to - 21.45 kg (2001), respectively (Table 3). The mean for TLMY1 (selected) varied from 2161.60 (2000) to 3765.90 kg (2009). The values for AFC's and TLL1's for different years varied from 943.63 (2000) to 1037.89 d (2004) and 234.08 (2000) to 319.12 d (2009), respectively (Table 3). The age at completion of first lactation and per day milk yield varied from 1177.71 (2000) to 1328.92 d (2007) and 8.15 (1999) to 12.48 kg/d (2004). The range for period in between point of AFC and 24 months of age varied 213.63 (2000) to 307.89 d (2004). The rearing cost of Vrindavani first calvers (up to completion of first lactation) varied from Rs. 69944.42 (2000) to Rs. 79570.22 (2009). At the same time, the value of milk realized through sale of milk only (ignoring cost of dung and cost of calf of any sex aged from one day to 10 months – up to completion of first lactation) varied from Rs. 47555.20 (2000) to Rs. 82849.80 (2009, Table 3).

Finally, by subtracting the rearing cost (up to completion of first lactation) from the value of milk realized through sale of milk of selected first calvers, the overall loss / profit (in Rs.) was estimated for different years of the study which ranged from Rs. (-) 22389.22 (2000) to Rs. 3279.58 (2009). It has been observed that at the initial point of study (1999) the loss was to the tune of Rs. (-) 20864.10 which increased to Rs. (-) 22389.22 during the year 2000. However, beyond this point, as an impact of culling in Vrindavani cattle the loss gradually decreased over years and reached to a point of Rs. (-) 44.42 (2007). Again, it increased during 2008 and reached to a point of Rs. (-) 1094.98, but, beyond 2008, the directional selection had resulted into a profit of Rs. 3279.58 (2009) in rearing selected first Vrindavani calvers (up to completion of first lactation) which is due to impact of continuous culling in the herd (Table 3 & 4). Stott (1994) found that the optimal herd life for cows in the United Kingdom was sensitive to changes in replacement heifer prices. As the price farmers receive for selling cull cattle increases relative to replacement heifer price,

it becomes less expensive from a capital investment perspective to cull and replace a given animal.

CONCLUSION

To earn maximum profits up to completion of first lactation it needs scientific culling of low yielders/ specifically first calvers should be done. The cows should not be auctioned or transferred before the completion of first lactation. Although, animals expressing poor TLMY's in early parity along with shorter lactation lengths and poor AVMYL should be culled as early as possible.

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