2007

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Livestock Research for Rural Development 19 (1) 2007 | Guidelines to authors | LRRD News | Citation of this paper

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Abstract

Data consisting of 5670 lactation records made by 2958 cows between 1990 and 2004 from 18 Ayrshire herds were used to evaluate the efficiency of the current bull dam selection method in Kenya. A univariate DF-REML procedure and the animal model with relationship was used to estimate Breeding Values (BVs) for unadjusted total lactation milk yield, as used by the current methodology.

The mean milk yield was 4085 Kg with SD of 1396 Kg, and the breeding values (BVs) for milk yield for all the animals ranged from - 979 kg to + 1115 Kg. with a heritability of 0.18 ± 0.045. The BVs were then arranged in descending order and then ranked. Based on the unadjusted lactation records, the BVs for the top 100 cows ranged from +550 Kg to +1115 Kg. Only 25 of the 113 bull dams that were included in the study were ranked in the top 100 cows.

The results indicate that there are a large number of cows in the national herd with high genetic merit that had been left out of the breeding programme using the current bull dam selection methodology and that cows with lower genetic merit have been used due to the inefficiency of the current bull dam selection method. Thus, the current method of bull dam selection is inefficient and needs to be improved by genetic evaluation of all the cows before bull dam selection.

Key Words: Bull dams, rankings, selection milk yield

Introduction

The main breeding objective for dairy cattle is to increase the genetic merit for milk yield at an economic cost. Dairymen are constantly concerned with the improvement of their herds by breeding elite cows to elite bulls, and in Kenya most dairy farmers rely on the semen from the Central Artificial Insemination Station (CAIS) for their breeding. Dairy cattle improvement is expressed most frequently as increased milk production and less often in terms of changes in body conformation. Improvement in milk production can be considered as being caused by environmental and genetic improvement. Both factors contribute to variation in milk production. The genetic improvement is dependent on various factors including proper record keeping, large active breeding population, having breeding objectives and high intensity and accuracy of selection. For any country, breeding objectives need to be outlined and regularly updated to cope with changes in the consumer environment. Dairy cattle improve because breeders choose the best bulls and the best cows to be parents of the next generation. Definitions of what is best and methods of selection have become more scientific overtime (Van Randen 2004). Breeders have to plan ahead because genetic choices made today will improve profit only in future generations, a review of past selection objectives maybe of use in determining new selection goals.

The current bull dam selection criteria in Kenya were set when the National Dairy Cattle Breeding

Programme (NDCBP) was started in 1969 (Mosi 1984) and few changes have been made since then. The number of cows required to produce young bulls for the progeny testing scheme was first estimated by Meyn (1969) and he estimated that 500 cows were required to produce 10 young bulls per breed annually. Poschinger (1978) also using mathematical models estimated that 125 cows were required to produce 10 young bulls per breed annually. Since then no other study has been done although the management and production systems have changed greatly. Rege (1991) using the Kenya Holstein -Friesian breed showed that no substantial improvements in the Kenyan population had been achieved after 20 years of the NDCBP implementation. Allaire and Gibson (1992) showed that in developed countries, the genetic trend in milk production per cow was steadily increasing; this acceleration in the annual gain has occurred because selection has been increasingly intensive and focused. Shook (2006) has shown that increases of up to 3500 Kg of milk per cow per lactation can be achieved from improvements in genetics, nutrition and management and that genetics accounts for about 55% of the gain in the milk yield.

Of the four pathways of gene transfer i.e. Bulls to produce Bulls (BB), Cows to produce Bulls (CB), Bulls to produce Cows (BC) and the Cows to produce Cows (CC), studies by Mosi (1984) have shown that the BB and CB pathways are the most important in the contribution to the genetic progress as they each contribute about 40%.

The Ministry of Livestock and Fisheries Development (MLFD) 2004, annual report indicated that only 8 bull dams were recruited in 2003 and 12 in 2004 from the four dairy breeds. This is a very low figure compared to what Poschinger (1978) had recommended and this implied that only about 1 to 2 bulls were recruited per breed per year into the NDCBP. This could imply the inefficiency in the bull dam selection method. It is, therefore, necessary to evaluate the current bull-dam selection methodology.

The current bull dam selection method is based on within herd selection i.e. there is no comparison of cows between herds. A cow that is superior in one herd may not necessarily be so in another herd. This could be a weakness in the selection criteria as the management in the various herds is very varied. The current selection criteria as in Table 1 was set by the Bull Purchasing Committee (BPC), which is responsible for recruiting bull dams for the Contract Mating Scheme (CMS) and the breed societies around 1969 when the NDCBP was initiated.

Table 1. Bull purchasing committee criteria for bull dam selection

Trait	Criteria	Range used
Calving Interval, Days	≤ 420	300 to 420
Lactation Length, Days	≥199	180 to 365
Parity, No.	≥ 3	3 to 12

These criteria has not been reviewed since then hence the need to assess its efficiency. Therefore, the objective of this study was to review the current bull dam selection methodology and to determine its efficiency in selecting bull dams for the NDCBP.

Materials and methods

Data used in this study were obtained from 94 Ayrshire herds that were officially milk recorded by the Dairy Recording Services of Kenya (DRSK) between 1990 and 2004. Additional information on the bull dams was sourced from files kept at the Central Artificial Insemination Station (CAIS). The farms were mainly located in the Rift Valley and Central provinces of Kenya. The management and production systems vary greatly from low input to high input production systems. The assumptions made were that all cows that were milk recorded during the study period had the potential to become bull dams. The study included all cows that were born between 1983 and 2001. The data was from 18 Aryshire herds made by 2958 cows of which 113 were bull dams (Table 2).

Table 2. Structure of the available and analyzed data

	Total records	Number used in study
Herds	94	18
Cows	3606	2958
Bull dams	134	113
Records	7827	5670

Records of animals without birth and calving dates, and those without parents were edited out. Herds with less than 50 records were also omitted, as all of them were found to be recording inconsistently, and if included in the analysis, they would have caused confoundment in the statistical analysis.

The seasons were divided into three using the procedure of Rege and Mosi (1989). These where;

Season 1: Long rains March to May.
Season 2: Short rains October to November
Season 3: Dry period December to February; June to September.

Statistical data analysis

The data was further sorted according to the bull purchasing committee criteria for selecting bull dams, which include; the calving interval of the cows should be less than 14 months, the lactation length should more than 199 days and the cows should have had at least 3 lactations.

The DF-REML statistical package and the animal model with relationships were then used to estimate the breeding values of the cows without adjusting the records. The cows were then arranged in descending order according to their breeding values and then ranked. The number of bull dams appearing in the top 100 cows was then determined.

The following model was used in the analysis.

$$Y_{ijklmn} = m+H_i + Yoc_j + Soc_k + Yob_m +P_l + A_n + e_{ijklmn.}$$

Where;

Y_{ijklmn} = the actual lactation milk yield record of the n^{th} cow born in the m^{th} year in the i^{th} herd of the l^{th} parity and calved in the j^{th} year and k^{th} season.
m= the underlying constant common to all lactation records.
H_i = the fixed effect of the i^{th} herd (i=1,2,3…. 18)
Yoc_j = the fixed effect of the j^{th} year of calving (j=1990, 1991… 2005)
Soc_k= the fixed effect of the k^{th} season (k= 1, 2, 3)
Yob_m= the fixed effect of the m^{th} year of birth (m= 1983, 1984 … 2001)

P_l= is the fixed effect of the l^{th} parity (3, 4, 5…. 12)

A_n=is the random effect of the n^{th} animal NID $(0,\delta^2{}_A)$.

e_{ijklmn}= is the residual error term NID $(0,d^2{}_{e})$.

Results and discussion

After sorting the cows according to the criteria used by the BPC in selecting bull dams, 21 of the bull dams that had been selected were eliminated from the data used in the analysis. This implies that though these 21 cows had been used in the breeding programme, they had been selected inefficiently and should not have qualified to be used as bull dams as they did not even meet the current criteria set by the BPC.

The mean milk yield per lactation was 4085 Kg with SD 1396 Kg, the large standard deviation shows how varied the cows are, though this could mainly be due to the large variation in management in the herds. The mean milk yield appears to be high because in Kenya farmers seem to officially milk record only those cows in their herds that are performing well and also give them a preferential treatment. The mean national milk yield per lactation for the Ayrshire cattle has not been officially computed but it is estimated to be below 2000 Kg (MLFD 2004).

Of the 94 herds that had records, 76 were omitted from the analysis because they had records that were inconsistent and not evenly distributed over the years; if these were to be included in the data then they would have caused confounding of the results. It was also observed that out of the 94 herds only 11 had contributed bull dams to the contract-mating scheme over the years of the study and that only 113 bull dams out of the 134 that had been recruited during the study period were included in the analysis. This shows that there could have been a bias during the selection of the herds from where the bull dams were selected. It appears that the selection was geared towards the large-scale herds. Though most large-scale herds have good records, this does not imply that the cows in these herds are genetically superior to those in the small-scale herds.

The BVs for milk yield, estimated without adjusting for environmental and systematic factors ranged from - 979kg to + 1115 Kg, with a heritability 0.18 and standard error 0.045 for all the animals. The cows were ranked in descending order according to their genetic merit for milk yield. The BVs for the top 100 cows ranged from + 550 Kg to + 1115 Kg.

Of the 113 bull dams that were used the analysis, only 25 appeared in the top 100 cows based on their breeding values for milk yield. This indicates that the current criteria for selecting bull dams have been leaving out many cows with high genetic merit for milk yield from the NDCBP. Since 21 cows that had been selected to the breeding programme were eliminated from the analysis, this underlines the inefficiency of the bull dam selection methodology; this inefficiency could also explain the decline in the genetic trend in milk yield that has been reported in previous studies (Mosi 1984, Rege and Mosi 1989, Rege 1991 and Ojango 2000). Since, the CB pathway contributes about 40% to the total genetic merit as shown by Mosi (1984) it is important that the bull dams are selected efficiently if positive genetic gain in milk yield is to be attained in future. There is, therefore, an urgent need to change the criteria that is currently being used in selecting bull dams.

Conclusions and recommendations

This study has shown that there are bull dams that have been selected and used in the NDCBP that did not even meet the criteria that was set by the BPC, it has also shown that there are many other cows in the national herd with high genetic merit for milk yield but have not been used in the NDCBP. This, therefore, means that the current method of selecting bull dams is inefficient as it has been missing out cows with high genetic merit from the national breeding programme and hence needs to be reviewed. This inefficiency of the bull dam selection methodology could have partly contributed to the negative genetic trend in milk yield that has been reported in other previous studies over the years.

Selection criteria should be determined by all the stakeholders in the dairy industry, putting into consideration the future needs of the dairy industry, as genetics chosen today will be used in 5 to 7 years. Geneticists should then develop selection indices for the different dairy breeds that can be used in the selection procedure if we are to achieve positive genetic trends in milk yield in future.

Genetic evaluations should be done regularly preferably every six months and the results should be used during the selection of bull dams. A study needs to be done to determine the number of bull dams per breed required to produce young bulls for progeny testing annually.

Acknowledgements

I would like to acknowledge the following:

The Dairy Recording Services of Kenya and the Central Artificial Insemination Station for availing the data for use in this study.

Elizabeth and Jane from the Department of Animal Production University of Nairobi for their assistance in the preparation of this paper.

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Received 30 October 2006; Accepted 19 November 2006; Published 1 January 2007

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