

ESTIMATED BREEDING VALUES AND GENETIC TREND FOR 305- DAY MILK YIELD IN BUFFALO HERD AT LES CHAK KATORA

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Data on 1524 pedigrees, breeding and performance records of 447 Nili-Ravi buffaloes maintained at the Livestock Experiment Station, Chak Katora, (Bahawalpur), Punjab, Pakistan during the period 1989 to 2007 were utilized in this study to identify the high yielding elite buffaloes/bull mothers (dams) to retain for further breeding for the ongoing progeny testing program in Punjab. The lactation records up to 9th parity were used for the analysis. The data were analyzed through Best Linear Unbiased Prediction (BLUP) procedure. The breeding values were estimated by fitting an individual animal model. The least squares means for 305-day lactation milk yield was 2030.13 ± 14.58 litre. The average lactation length was 260.42 ± 1.35 days. Of 447 buffaloes, 284 had positive breeding values (EBVs) and 90 were declared as elite buffaloes. The estimated breeding values for milk yield from animal model evaluations ranged from -323.40 to +345.12 kg. The genetic trend for 305-day lactation milk yield depicted a deteriorating trend indicating that breeding strategy proved to be inefficient during the last 20 years.

Keywords: Animal model, estimated breeding values, 305-day milk yield, buffaloes

INTRODUCTION

In Pakistan, there are 28.4 million head of buffaloes, which play a key role in the rural economy of the country. Buffaloes provide more than 58 % of milk consumed in the country (Anonymous 2006). The Nili-Ravi is well known for her superior dairy qualities among the world buffalo breeds. There is a wide variation in the production potential of this breed, which can be exploited through selective breeding. The Livestock Experiment Station Chak Katora (Bahawalpur) is one of the important nucleus Nili-Ravi buffalo herds used for the genetic improvement of animals through selection of bull dams and progeny testing program.

The ultimate goal in animal breeding is to rank breeding animals according to their genetic merit for the desired characters and to use them efficiently in breeding. The genetic evaluation of animals is, therefore, a key issue.

The accuracy of identifying genetically superior animals is the basic requirement for genetic improvement through selection. Assessment of the true breeding value of an animal is not possible. Instead, estimated breeding values (EBVs) are calculated which are estimates of the true breeding value of an animal. Best linear unbiased predictions (BLUP) procedure using the individual animal model (IAM) has become the world wide standard for the predication of breeding values of farm animals (Hill and Meyer, 1988).

The present study was therefore, planned to estimate the breeding values of the animals for comparative ranking for 305-day lactation milk yield in the buffalo

herd of Livestock Experiment Station Chak Katora (Bahawalpur), Pakistan using BLUP procedure. The information so generated will be used in optimizing the future breeding programmes for genetic improvement of the buffalo population in the country.

MATERIALS AND METHODS

The data on 1524 pedigree, breeding and performance records of 447 Nili-Ravi buffaloes maintained at the Livestock Experiment Station Chak Katora (Bahawalpur), during 1989 to 2007 were utilized for the present study. The data on 305-day milk yield was analyzed to estimate the breeding value for 305-day lactation milk yield. Incomplete lactations for any recorded reason or lactations showing any abnormality were not utilized in the analysis. Records having less than 60 days of lactation length were not used. Data were checked for other unrealistic entries. Records outside a range of 3 standard deviations from the phenotypic mean were also removed (Ahmad, 2007). The total number of records eliminated due to editing was 38, which was less than 3% of the total. All the valuable information was included in the analysis to minimize the bias due to selection and non-random mating.

The parameters included were identity of animals, sire, dam, dates of birth, calving, drying, lactation number (parity), lactation length and 305-day lactation milk yield. The data were analyzed to estimate the phenotypic and genetic parameters of 305-day lactation milk yield. General Linear Mixed Model of statistical Analysis System (SAS, 1998) was used to

study the factors affecting 305-day lactation milk yield. The fixed effects, year of calving (19 years), season of calving (5 seasons) and lactation number/parity (No. 9) found significant. The linear as well as quadratic effect of age at calving on 305-day lactation milk yield showed non-significant variations hence, excluded from the model. For estimation of breeding values (EBVs) random animal effects and permanent environmental effects were also included in the model. In matrix notation, model assumed can be written as follows:

$$y = Xb + Za + Wpe + e$$

Where

y = vector of observations

b = vector of fixed effects

a = vector of random animal effects

pe = vector of random permanent environment effects

e = vector of random residual effect

X, **Z**, **W** are incidence matrices relating records to fixed, animal and permanent environment effects respectively. Note that

$$Z = [0 \ W]$$

Where, **0** are extra columns added for the ancestors without records.

Vector **a** contains additive random animal effects while possible non-additive genetic effects would be included in the **pe** vector.

It was further assumed that permanent environment effects and residual effects are independently distributed, with mean zero and variance σ^2_{pe} and σ^2_e respectively.

So the variances are therefore, defined as:

$$\text{var}(\text{pe}) = I\sigma^2_{pe}$$

$$\text{var}(e) = I\sigma^2_e = R$$

$$\text{var}(a) = A\sigma^2_a$$

$$\text{var}(y) = ZAZ' \sigma^2_a + W I \sigma^2_{pe} W' + R$$

The mixed model equations (MME) for the best linear unbiased estimator (BLUE) of estimable functions of **b** and for the best linear unbiased prediction (BLUP) of **a** and **pe** pertaining to this model (Mrode, 1996) are then:

$$\begin{bmatrix} XX' & X'Z & X'W \\ Z'X & Z'Z + A^{-1}\alpha_1 & Z'W \\ W'X & W'Z & W'W + I\alpha_2 \end{bmatrix} \begin{bmatrix} \hat{b} \\ \hat{a} \\ \hat{pe} \end{bmatrix} = \begin{bmatrix} X'y \\ Z'y \\ W'y \end{bmatrix}$$

where $\alpha_1 = \sigma^2_e / \sigma^2_a$ and $\alpha_2 = \sigma^2_{pe} / \sigma^2_{pe}$

Breeding values of animals for 305-day lactation milk yield were estimated by Best Linear Unbiased Predictions (BLUP) procedure, as outlined by Henderson (1973). Model used for this purpose was an animal model. The genetic parameters used were the same for genetic evaluations. The additive genetic

effects were estimated by using DFREML computer set of programmes (Meyer, 2000). This program also generated breeding values of animals for 305-day milk yield as a by-product. Breeding values thus estimated were fitted in a fixed effect model (SAS, 1998) having year of birth as the only fixed effect. The least squares solutions of breeding values were drawn against year of birth to predict the genetic trend.

RESULTS AND DISCUSSION

The least square means for 305-day lactation milk yield was 2030.13 ± 14.58 litres, while the average lactation length as observed was 260.42 ± 1.35 days in the said herd. The estimates were lower than some of the earlier reports (Ahmad *et al.*, 2003 and Ahmad, 2007). The estimated breeding values for milk yield from animal model evaluation varied widely (from -323.40 to +345.12 kg), average being 46.18 kg, for the Nili-Ravi buffaloes maintained under the period of study. Of 447 buffaloes, 284 have positive breeding values while 163 buffaloes have negative breeding values. Within the 284 buffaloes (EBVs⁺), 90 were declared as elite buffaloes / bull mothers. The genetic trend for 305-day lactation milk yield depicted a deteriorating trend (Figure 1), indicating that breeding strategy proved to be inefficient during the last 20 years. Similarly, Khan (1998) also reported a negative genetic trend for a different data set on Nili-Ravi buffaloes in Pakistan. It also indicated that the selection of animals could not be practiced in the proper direction and some sort of random mating had been practiced in the said buffalo herd. The young bulls were selected on the basis of milk yield of their dams with no consideration of their breeding values. Due to negative genetic trend the genetic improvement in milk yield as expected could not be attained through selection. This could be only possible in a broader genetic base and in the larger buffalo herds. There were some other limitations too, which created hindrance in the genetic improvement. The culling in the herd under study was not according to the recommended level and mostly animals unfit for breeding, repeaters or sick were disposed off. The culling on the basis of low production was rarely practiced. Moreover, high milk yielding animals had to be disposed off during some outbreaks of highly contagious diseases i.e. brucellosis and tuberculosis etc. It could be inferred from the present study that in the presence of various factors, the selection was not really effective to bring about the desired changes over 20 years.

The possible reason for ineffective selection could be unavailability of efficient selection/breeding techniques for the evaluation of animals, smaller herd size,

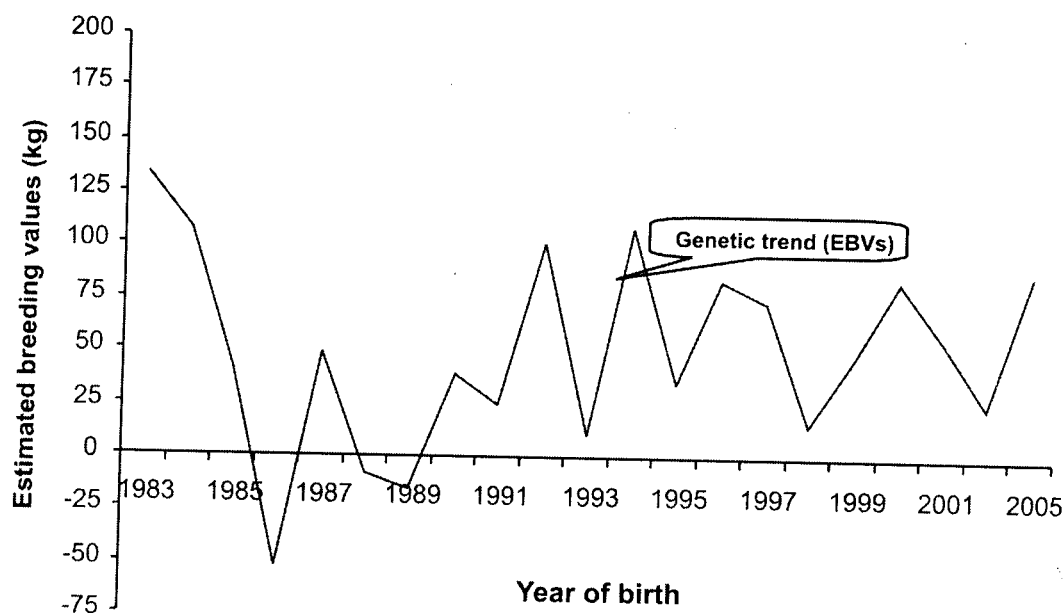


Fig. 1. Genetic trend for 305-day lactation milk yield in Nili-Ravi buffaloes

inbreeding and lack of accuracy in performance recording etc. in the past. However, some improvement in the genetic trend in the year 2005 indicated that some good sires were used in recent years and the breeding strategy was also improved. In short, the performance traits in the said herd would need further improvement. It is therefore, imperative to emphasize improvement in husbandry/ management and breeding evaluation techniques.

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