Estimation of genetic and phenotypic trends for service based heifer and cow fertility traits for South African Holstein cattle

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Introduction

- Reproductive performance is among the key drivers of profitability and financial sustainability of dairy herds.
- The negligence of fertility due to its low heritability while selecting for increased milk yields has led to a reduction in reproductive efficiency in the past years, due to the antagonism that exists between the traits.
- Inclusion of fertility into dairy cattle breeding heightened worldwide from as early as the 1990s due to its economic importance.
- Evaluation of genetic progress could lead to establishment of future genetic direction by defining specific goals for breeding a profitable and sustainable dairy herd.

Aim

The aim of this study was to estimate breeding values (EBV), genetic and phenotypic trends for heifer and cow fertility traits of South African Holstein Cattle.

Materials and Methods

AI performance data

- AI Service data were collected from 18 SA Holstein herds (n=64 464).
- Pedigree data included animals born between 1992 and 2013
- The data set included information on birth date, service and calving dates of each animal, lactation number of dam and sire identification numbers, from which the following traits were defined:

Heifer traits
✓Age at first service (AFS)
✓Age at first calving (AFC)

Cow traits
✓Number of services per conception (SPC)
✓Calving to first service (CFS)
✓Days open (DO)

Statistical Analysis

- Editing and descriptive statistics were performed in R-CRAN.
- Model effects for genetic evaluations were tested using the lme4 package (Bates et al., 2015) in R
- Models: $y_{cow_{ijklmn}} = hys_i + lact_j + agec_k + a_l + pe_m + e_{ijklmn}$

  $y_{heifer_{ijk}} = hys_i + a_j + e_{ijk}$
- Multivariate analyses were carried out to estimate variance components which were subsequently used to estimate breeding values using THRGIBBS1F90 and POSTGIBBSF90 of Blupf90 family of programs (Misztal *et al.*, 2018).
- Genetic and phenotypic trends were determined by averaging the estimated breeding values and phenotypes by year of birth and plotted using ggplot2 package in the R software (Wickham, 2016).

Results and Discussion

Table 1: Descriptive statistics of fertility traits in South African Holsteins

	CFS	DO	SPC	AFS	AFC
No. of obs	24 909	24 909	24 909	10 019	10 019
Mean	89.6	137	2.18	16.8	26.7
SD	36.6	71.9	1.57	3.51	3.9
Min	21	21	1	10	20
Max	250	435	10	30	48

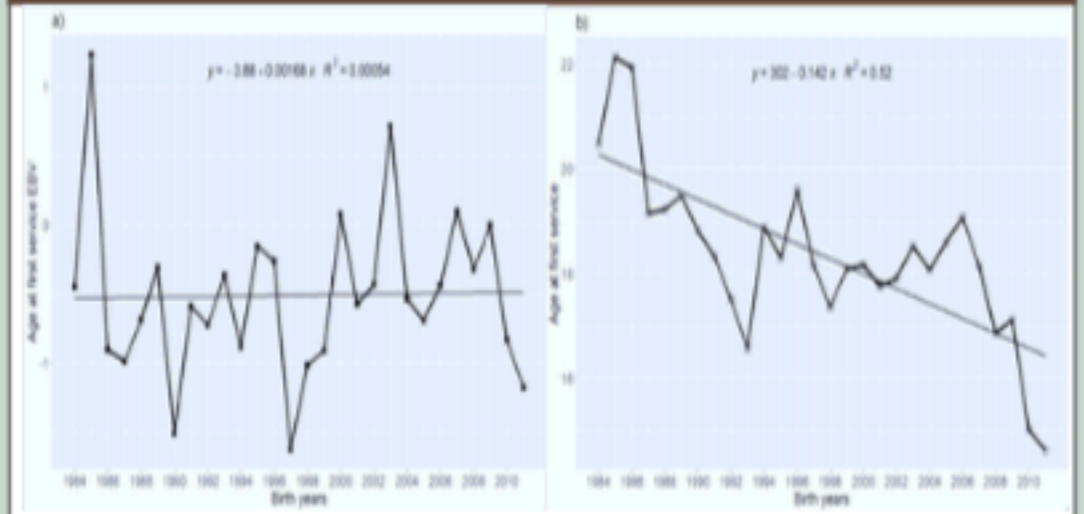

Figure 1. The genetic (a) and phenotypic (b) trends for AFS

- The descriptive statistics shows averages which were higher than most reported values for the same breed.
- The SPCh in heifers was lower (1.54) than in cows (2.18), indicating that younger heifers require fewer inseminations on average for conception than the older cows.
- This is somewhat expected as heifers have not yet started lactating to effect genes underlying production i.e., the pleiotropic effect of genes is not initiated.
- In general, we observed similar trends for all the defined traits, and in this paper, we present AFS trends for demonstration purposes.
- As shown in Figure 1, there was no genetic trend for AFS while the phenotypic trend showed steady improvement. The improvement in the phenotypic trend without any change in the genetic trend indicates that improvement in the trait may be due to improved reproduction management strategies and good nutrition while no emphasis was given by the breeder to improve fertility genetically.

Conclusions and Recommendations

- Generally, the average breeding values and phenotypic means for heifer and cow fertility traits were not desirable indicating that farmer's intervention is required to improve the reproductive performance of South African Holstein dairy cattle through genetic selection.

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