



Estimation of Phenotypic and Genetic Trends in Economic Traits of Murrah Buffaloes

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ABSTRACT

Background: Notable advancements in the selection indices have led to the development of exceptional breeding strategies, which have eventually led to the selection of elite dairy animals. The comparison of trends is facilitated by their estimation which permit the assessment of progress in a particular trait. The purpose of this study was to investigate genetic trends in economic traits of Murrah buffaloes, which is predominantly present as a high milk producer using the regression method. The study was designed to estimate the phenotypic, genetic and environmental trends, which represent the changes accrued over time and hence, determines the efficiency of breeding programme.

Methods: The present study was conducted on 659 Murrah buffaloes, sired by 188 bulls, over a period of 27 years (1991-2017). The economic traits studied were first lactation milk yield (FLMY), first lactation length (FLL), age at first calving (AFC), first calving interval (FCI), first service period (FSP) and first dry period (FDP). The phenotypic trends were obtained as regression of population performance on year and the genetic trends were obtained by Smith method I and II.

Result: The results revealed that the phenotypic trends obtained were significant and desirable for all the traits except for first lactation length, which was non-significant. The standard errors obtained by Smith method-I were higher than those obtained from method-II. As the Smith method-II avoids year to year fluctuations in the environment and those of contemporaries, it gives more realistic estimate as compared to the first method with lower standard error.

Key words: Age at first calving, First lactation traits, Genetic trend, Murrah buffaloes, Phenotypic trend.

INTRODUCTION

Remarkable changes in selection indices over the years have brought breeding skills par excellence in the breeding strategies. The concept is visible in all bovine animals particularly in cattle and buffaloes. During the last few years, the main emphasis in selecting a buffalo is primarily based on estimated breeding value on milk yields, which synergises with the goal of a dairy breeder. The idea of optimal breeding has necessitated the estimation of change per year in a population. Estimation of trends are essential because they permit comparison of realized trends with expected one in a given situation and the assessment of progress in a particular trait. To measure the genetic trend for milk production, environmental and genetic portions needs to be partitioned from the phenotypic trend. The phenotypic trend and genetic trend, in fact, result from change in the mean breeding value due to selection. Environmental trends accrue because of cumulative change in various non-genetic factors. The purpose of this study was to investigate genetic trends in economic traits of Murrah buffaloes, which is predominantly present as a high milk producer, from the regression method as proposed by Smith (1962).

MATERIALS AND METHODS

The present investigation was carried on 659 Murrah buffaloes, sired by 188 bulls, maintained at Directorate of Livestock Farms, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, for the duration of 27 years (1991-2017). The economic traits under study were first

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lactation milk yield (FLMY), first lactation length (FLL), age at first calving (AFC), first calving interval (FCI), first service period (FSP) and first dry period (FDP). Among the first lactation records, the abnormal lactation records due to culling, abortion, pre-mature birth, still birth and death were excluded. Each year was divided into four seasons on the basis of atmospheric temperature and relative humidity.

Estimation of phenotypic trends

The phenotypic trends were estimated for each trait by taking the regression of performance of the population on year as $b_{(P,T)}$. The standard error of phenotypic trend was estimated as:

$$S.E.(\Delta P) = \left[\frac{\sum P^2 - b_{P,T} (\sum Pt)}{(\sum t^2)(N-2)} \right]^{1/2}$$

Where,

$b_{P,T}$ is the progeny performance (P) on time (T)

N is the number of observations

Estimation of genetic trends

The methods employed for the estimation of genetic trends, used in the present study, were as proposed by Smith (1962) i.e. method I and II:

Smith method- I

$$\hat{g} = 2(b_{P,T} - b_{P,T/S})$$

i.e. twice the difference in the regression performance on time and pooled intra_sire regression of sire progeny performance on time.

Smith method- II

$$\hat{g} = -2 [b_{(P - \bar{P}),T/S}]$$

i.e. negative twice the pooled intra-sire regression of the records of sire progeny on time, each record being expressed as a deviation from the herd mate average.

Where,

$\hat{g}$ = genetic trend

$b_{P,T}$ = is regression of population performance on time

$b_{P,T/S}$ = is within sire regression of progeny performance on time

$b_{(P - \bar{P}),T/S}$ = is within sire regression of progeny performance on time record being deviated from population mean.

Estimation of environmental trends

Environmental trend (ΔE) was obtained by subtracting the genetic trend (ΔG) from the overall phenotype trend (ΔP).

$$\Delta E = \Delta P - \Delta G$$

The standard error of environmental trend, SE (ΔE) was calculated as:

$$S.E. (\Delta E) = \sqrt{S.E.(\Delta P)^2 + S.E.(\Delta G)^2}$$

Comparison of methods

Among the methods used for the evaluation of genetic trend, the most superior and suitable method was selected on the basis of standard error. The method with the least standard error represented the most precise and best method for the estimation of Genetic trend.

RESULTS AND DISCUSSION

The annual genetic and phenotypic trends, estimated for various economic traits, assist in evaluating the effectiveness of previous selection strategies. The phenotypic trends are presented in Table 1. The year-wise means of the production and reproduction traits are represented through Fig 1-3. The results of the genetic and environmental trends evaluated in the present study are shown in Table 2.

First lactation milk yield (FLMY)

The value of the phenotypic trend as calculated for the first lactation milk yield was found to be significant ($p < 0.01$) and positive as 32.45 ± 4.07 kg/year. This positive and significant value is in the direction of improvement which is indication of good managerial practices and feeding management

Table 1: Phenotypic trends for various economic traits.

Trait	Phenotypic trend
First lactation milk yield (kg/year)	32.45 ± 4.07
First lactation length (days/year)	0.518 ± 0.53
Age at first calving (days/year)	-9.104 ± 1.28
First calving interval (days/year)	-2.176 ± 0.78
First service period (days/year)	-2.182 ± 0.76
First dry period (days/year)	-1.764 ± 0.61

Table 2: Genetic and environmental trends in various economic traits.

Trait	Trend	Smith method	
		SM I	SM II
FLMY	ΔG	10.21 ± 8.53	4.85 ± 2.10
	ΔE	22.23 ± 9.45	27.60 ± 4.58
FLL	ΔG	-0.14 ± 1.08	-1.18 ± 0.15
	ΔE	0.66 ± 1.21	0.66 ± 0.55
AFC	ΔG	-14.22 ± 2.56	2.54 ± 0.55
	ΔE	5.22 ± 2.87	-11.65 ± 1.39
FCI	ΔG	-3.89 ± 1.64	0.45 ± 0.13
	ΔE	1.72 ± 1.82	-2.63 ± 0.79
FSP	ΔG	-2.51 ± 1.52	0.16 ± 0.04
	ΔE	0.32 ± 1.70	-2.34 ± 0.76
FDP	ΔG	-2.56 ± 1.22	0.19 ± 0.08
	ΔE	0.80 ± 1.37	-1.96 ± 0.61

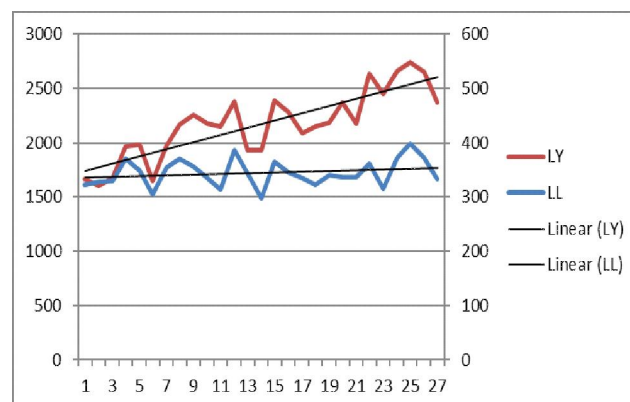


Fig 1: Year-wise means for FLMY and FLL.

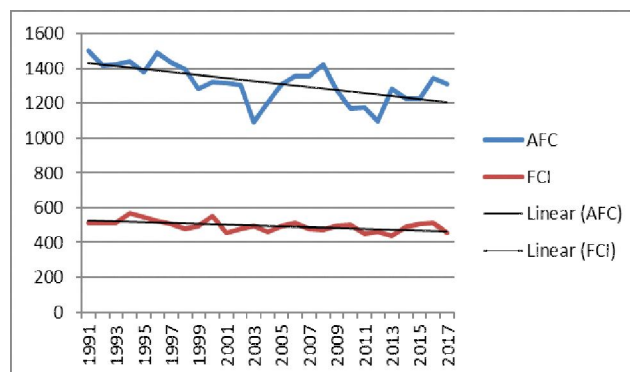


Fig 2: Year-wise means for AFC and FCI.

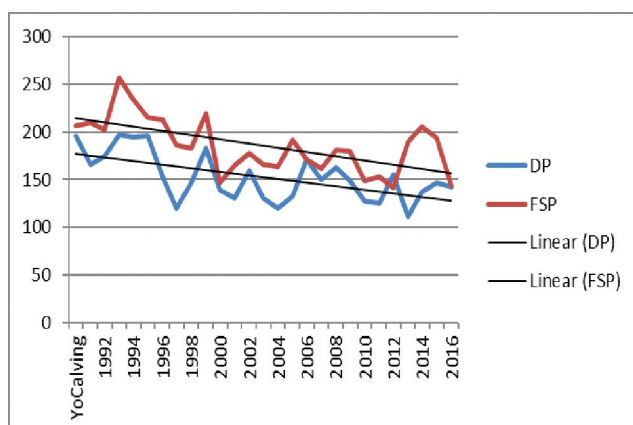


Fig 3: Year-wise means for FSP and FDP.

at farm. The results are in consistent with other reports in the literature such as Nehara *et al.* (2013) and Chaudhary (2018). The estimates of genetic trend were found positive and in the desirable direction. However higher values of environmental trend revealed good management practices of the farm. Negative genetic trends were reported by Chakraborty and Dhaka (2012), but Chaudhari *et al.* (2014) also reported positive trends.

First lactation length (FLL)

the phenotypic trend for first lactation length was found to be 0.518 ± 0.53 days/year, which was non-significant ($p > 0.01$). This phenotypic change was associated to corresponding phenotypic change in milk yield. Similar results were reported by Sahana and Sadana (1998) and Chaudhari *et al.* (2014). Negative genetic trends were observed, although with low magnitude. The environmental trends were found to be favourable for the lactation length in the herd under study.

Age at first calving (AFC)

In the present study, significant ($p < 0.01$) phenotypic trend was observed for age at first calving. The estimate for phenotypic trend was observed to be -9.104 ± 1.28 days/year. The decreasing trend as observed in the present study is in the desirable direction. Similar pattern of phenotypic trends were reported by Chaudhari *et al.* (2014) and Chaudhary (2018). The genetic trend was found to be in favourable direction by method-I, but was observed to increase by method-II. However, negative genetic trends were observed by Nehara (2011) and Chaudhary (2018) by Smith method I and II. The positive genetic trend, observed in the present study by Smith method II demands the stringent selection of sires and dams in the herd.

First calving interval (FCI)

The phenotypic trends for first calving interval were evaluated to be -2.176 ± 0.78 days/year. This significant ($p < 0.01$) negative value of the trend shows the favourable direction of the trait over time and can further be improved by efficient heat detection and timely service programme. Similar results were reported by Chander (2002) and Dev

et al. (2017). Nehara (2011) and Chaudhary (2018), however, reported positive trends. Results indicated negative genetic trend by method-I but positive by method-II. Due to the effect of non-genetic factors, the trait can further be improved by managerial practices.

First service period (FSP)

A negative and significant ($p < 0.01$) phenotypic trend of -2.182 ± 0.76 days/year was observed in case of first service period. The negative trend of service period seems to be in desirable direction. The results were comparable with the findings of Dev *et al.* (2017) whereas, contrary results were presented by Chaudhari *et al.* (2014), Dash *et al.* (2016) and Chaudhary (2018) showing positive phenotypic trends in the trait. The negative genetic trend obtained by method-I, revealed that much of the phenotypic change has been contributed by efficient selection. The results were comparable with the findings of Chaudhari *et al.* (2014) and Chaudhary (2018). Positive genetic trends were reported by Dash *et al.* (2016) and Dev *et al.* (2017) for the trait.

First dry period (FDP)

Significant ($p < 0.01$) and negative phenotypic trend was reported in the present study for dry period with value as -1.764 ± 0.61 days/year. The negative phenotypic trend reveals the efficient production capacity of the herd in the desirable direction. Contrary results were reported by Ambhore *et al.* (2017). The positive genetic trend in the dry period, as obtained by method-II, indicate the major contribution of the environmental trend towards the phenotypic trend.

CONCLUSION

The present investigation revealed that the phenotypic trends obtained were significant and desirable for all the traits except for first lactation length, which was non-significant. The standard errors obtained by Smith method-I were higher than those obtained from method-II. As the Smith method-II avoids year to year fluctuations in the environment and those of contemporaries, it gives more realistic estimate as compared to the first method with lower standard error. These results were in conformation with the results of Powell and Freeman (1974), Hingane (1980), Singal (1993), Singh (2002) and Chaudhari *et al.* (2014). Hence, it is suggested that the genetic trends evaluated from Smith method-II are more precise than Smith method-I.

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