*Indian Journal of Animal Sciences* **90** (6): 890–892, June 2020/Article

# Estimation of genetic, phenotypic and environmental trends for production and reproduction traits in a flock of Corriedale sheep

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Received: 9 May 2019; Accepted: 21 October 2019

ABSTRACT

The aim of the present study was to estimate genetic, phenotypic and environmental trends for birth weight (BW), weaning weight (WW), six months body weight (W6), yearling body weight (W12) and age at first lambing (AFL). The genetic trends (gm), respectively, for BW, WW, W6 and W12 were 8, 44.22, 8.05 and 29.45 whereas for AFL it was –0.03 (day/year). The phenotypic trends (gm), respectively for BW, WW, W6 and W12 were –1.3, 36.06, –30.77 and 32.90 whereas for AFL it was 4.39 (day/year). The environmental trends (gm / year) respectively for BW, WW, W6, W12 were –9.3, –8.2, –38.83 and 3.45 whereas for AFL it was –4.36 (day/year). Positive and statistically significant genetic trends were recorded for all studied body weight traits whereas for AFL it was non-significant. Phenotypic trends for all the traits under study were statistically non-significant.

**Keywords**: Corriedale, Environmental trends, Genetic-trends, Phenotypic trend, Sheep, Traits

In an attempt to increase the productivity of local low producing sheep in Jammu and Kashmir, cross breeding was adopted for which various breeds of sheep were imported from time to time. These breeds are being maintained at various sheep breeding stations where from elite germplasm is distributed to field agencies for grading up of non-descript animals but for most of the period these breeding stations have acted as closed nucleus flocks. Corriedale is one such breed which was imported around 1970s. It is known for its good mutton conformation, good wool characteristics, relative early maturity and having good range characteristics. This breed is being maintained at sheep breeding farms as a pure breed. Sine this breed has contributed significantly to the increase in mutton production, it is important to study the genetic progress of this breed over the years under temperate agro climatic conditions of Jammu and Kashmir. For this, improvement programs are evaluated through the estimation of genetic trends which depict the effectiveness and efficiency of adopted selection procedures (Hamadani *et al.* 2019). In recent times, genetic trend is depicted as the average breeding value over years/periods. Harville and Hendeason (1966) described the genetic trend as change in production per unit of time due to change in mean breeding value. Hence, this study was undertaken to evaluate selection and breeding programme of a Corriedale flock maintained at one of the breeding stations.

## MATERIALS AND METHODS

For present study, the data sets were collected from Mountain Sheep and Goat Research Station, SKUAST-K, Shuhama, pertaining to a Corriedale flock, spanning over a period of 25 years from the year 1989 to 2013. The data was collected for traits, viz. birth weight (BW), weaning weight (WW), six month body weight (W6), one year body weight (W12) and age at first lambing (AFL) which were standardized, classified and then subjected to least square analysis for fixed effects of year of birth, sex of animal, type of birth and age of dam.

Multiple traits mixed model (DFREML) was used to estimate breeding values which also yielded the variance (covariance) components and corresponding genetic parameters. Convergence was assumed when the variance of likelihood values in the simplex was less than 10–8. In addition, a restart of each analysis was performed with different starting values to attempt to avoid convergence to local maxima. Besides random effects of the animals, fixed effects found statistically significant ($P<0.05$) during least square analysis were included for estimation of breeding values by using following animal model,

$$Y = Xb + Za + Zm + Zc + e$$

where Y is a $n \times 1$ vector of records; b, vector of fixed effects in the model with association matrix X; a, vector of direct genetic effects with association matrix Za; m, vector of maternal genetic effects with association matrix Zm; c, vector of maternal permanent environmental effects with association matrix Zc, and e, vector of residual (temporary environment) effects. The mean values of expected breeding values (EBVs) were calculated according to years of birth. Genetic trend was estimated by regression of average

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estimated breeding values on year of birth as per the equation,

$$Yi = b_0 + b_1x_i + e_i$$

where, $Y_i$, breeding values for the evaluated traits of the $i^{th}$ year of birth; $b_0$, intercept; $b_1$, coefficient; $x_i$, $i^{th}$ year of birth; $e_i$, random error.

Animal breeding values were obtained by adding the least square means of a given trait to the corresponding additive genetic effects extracted from the mixed model (Table 2). The least squares solutions of estimated breeding values were plotted against the year of birth to determine the genetic trend. After standardization of the data according to the fixed effects, the phenotypic trend was calculated as the linear regression of the adjusted means for a given trait on the years of birth. Environmental trend was calculated by subtracting genetic trend from the phenotypic one. Significance of the trends was determined by Minitab Statistical Software.

## RESULTS AND DISCUSSION

Estimates of trends for studied traits have been presented in Table 1. The estimates of annual rates of genetic progress for all studied growth traits in present study were significant and positively directed (P≤0.01). The genetic, phenotypic and environmental trends for BW are given in Figs 1, 2 and 3 respectively. The estimates are comparable with estimates of Shrestha *et al.* (1996) who estimated genetic trends for Canadian sheep for birth weight and 91 days of age as 13 and 23 g/year in Suffolk and 7 and 25 g/year in Finn sheep, respectively. Shaat *et al.* (2004) reported positive estimates of genetic change per year for W6 in Ossimi and Rahmani sheep. Mokhtari and Rashidi (2010) also reported positive and significant genetic trends in Kermani Sheep for Birth weight (P <0.05), WW, W6 and W12 (P<0.01). These results are higher than estimates obtained in this study, except for BW. El-Wakil *et al.* (2013) has also reported higher estimates of genetic trends of 15 g, 189 g, 448 g for BW, WW and W12, respectively in Barki sheep. Arora *et al*. (2010) has reported rates of genetic progress for WW, W6 and W12 in Malpura sheep as 60 g, 580 g, and 950 g, respectively. Few long-term experiments

Table 1. Estimates of trends

| Trait | Trend | g/year | F value | P value | R² |
|---|---|---|---|---|---|
| BW | Phenotypic trend | –1.3 | 0.04 | 0.842 | 0.001 |
| | Genetic trend | 8 | 73.34 | 0.000 | 0.761 |
| | Environmental trend | –8 | 1.46 | 0.239 | 0.071 |
| WW | Phenotypic trend | 36.06 | 0.46 | 0.503 | 0.020 |
| | Genetic trend | 44.22 | 209.47 | 0.000 | 0.905 |
| | Environmental trend | –8.2 | 0.02 | 0.881 | 0.001 |
| W6 | Phenotypic trend | –30.77 | 0.15 | 0.706 | 0.006 |
| | Genetic trend | 8.05 | 69.08 | 0.000 | 0.758 |
| | Environmental trend | –38.83 | 0.23 | 0.634 | 0.010 |
| W12 | Phenotypic trend | 32.90 | 0.37 | 0.550 | 0.007 |
| | Genetic trend | 29.45 | 7.83 | 0.010 | 0.422 |
| | Environmental trend | 3.45 | 0.10 | 0.758 | 0.00009 |
| AFL | Trend | days/year | F value | P value | R² |
| | Phenotypic trend | –4.39 | 2.13 | 0.158 | 0.088 |
| | Genetic trend | –0.03 | 1.33 | 0.261 | 0.057 |
| | Environmental trend | –4.36 | 2.13 | 0.158 | 0.087 |

Table 2. Estimated means of animal breeding values for body weight at birth, weaning, six months, twelve months (gram) and age at first lambing (day) according to birth years

| Year | BW | WW | W6 | W12 | AFL |
|---|---|---|---|---|---|
| 1989 | 1.118767 | –242.206 | 0.151629 | –26.94 | –0.91641 |
| 1990 | –25.2482 | –232.233 | –25.0748 | –10.002 | –0.70518 |
| 1991 | –52.987 | –43.8669 | –52.6817 | 210.32 | 1.21617 |
| 1992 | –3.59803 | 35.33033 | –3.27367 | 197.31 | 0.97698 |
| 1993 | 16.37474 | | | | |
| 1994 | 11.63171 | 131.9145 | 11.6658 | 110.21 | 2.5854 |
| 1995 | 13.0078 | 237.7982 | 12.72653 | 430.01 | 2.83455 |
| 1996 | 87.66397 | 83.05857 | 86.90254 | 318.43 | 1.40469 |
| 1997 | 33.35659 | 105.1935 | 32.77856 | 217.73 | –0.1941 |
| 1998 | –20.1298 | 142.0773 | –20.3793 | 187.02 | 0.2757 |
| 1999 | 25.34851 | –71.741 | 24.69146 | –204.33 | –0.1674 |
| 2000 | 76.30622 | 392.0887 | 75.96445 | 518.66 | 0.285 |
| 2001 | 54.65379 | 341.1829 | 54.29015 | 579.52 | 0.7005 |
| 2002 | 73.73532 | 390.4368 | 73.27603 | 556.51 | 0.68235 |
| 2003 | 92.21583 | 396.1327 | 91.46434 | 557.77 | 0.01524 |
| 2004 | 81.73767 | 476.4608 | 81.07296 | 521.37 | –0.39354 |
| 2005 | 149.0987 | 580.483 | 148.1986 | 713.12 | 0.57936 |
| 2006 | 83.01411 | 502.6222 | 82.2858 | 550.82 | 0.1293 |
| 2007 | 82.28439 | 445.0397 | 82.00492 | 696.42 | 0.0627 |
| 2008 | 91.73963 | 579.116 | 91.25713 | 987.77 | –0.39546 |
| 2009 | 220.5395 | 863.4399 | 218.8297 | 822.56 | 1.9125 |
| 2010 | 150.1573 | 781.1578 | 149.2829 | 735.32 | 0.522 |
| 2011 | 159.1785 | 813.9026 | 158.0054 | % | 0.1914 |
| 2012 | 135.3312 | 846.4719 | 135.1502 | 886.14 | –0.2568 |
| 2013 | 138.2946 | 838.9261 | 137.3339 | –26.94 | –0.9528 |

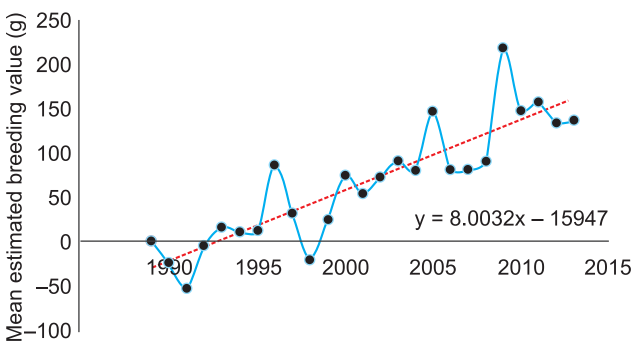


Fig. 1. Genetic trend for birthweight.

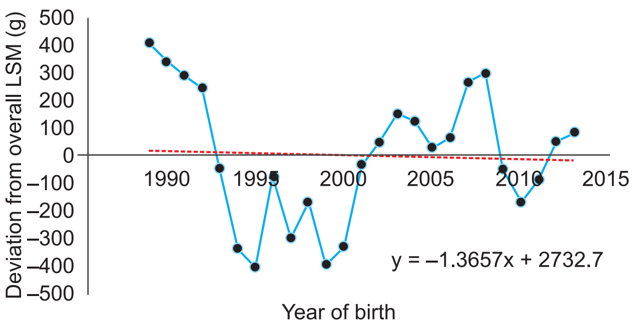


Fig.2. Phenotypic trend for birthweight.

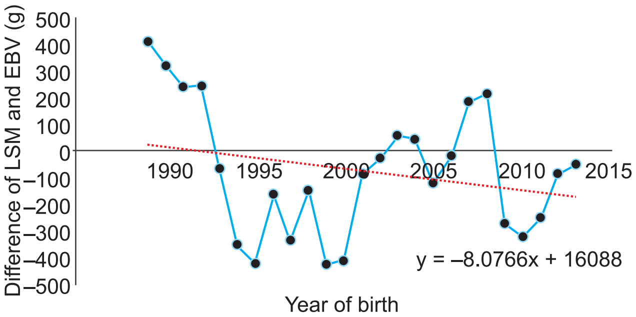


Fig. 3. Environmental trend for birthweight.

involving selection for growth rate alone have been carried out in sheep and an estimate of annual genetic trend of 620 g for 90 days lamb weight was reported by Lax *et al.* (1979). On the other hand, a negative estimate of annual rate of genetic response (–136 g) in the Indian Avivastra sheep for 180-day weight was reported by Singh and Dhillon, (1992). AFL also did not reveal any genetic trend which may be attributed to the fact that selection might not have been practiced for this trait.

Overall, the genetic gain for the studied growth traits is not very impressive as was also reported by Hamadani *et al.* (2019). Fluctuating trends in Kashmir Merino sheep for many traits were reported by Rather *et al.* (2019). This can partially be explained by the fact that the flock is a closed type and introduction of rams from outside nucleus was observed only once in last 35 years.

The estimates of phenotypic trends for all the traits were non-significant indicating no phenotypic gain in these traits over the period of study. They were negative in magnitude for all the traits except WW and W12. The curves of phenotypic trends for BW, WW, W6 and W12 appeared to have sharper fluctuations than that of the genetic ones over the examined years which might reflect the inconsistent management system exhibited by the environmental influence and managerial practices followed at the farm. The results for phenotypic trends are comparable to those reported by El-Wakeel *et al.* (2013) in Barki sheep. Singh and Dhillon (1991) reported a decline in phenotypic trend for W6 in Avivastra sheep. Genetic and phenotypic trends for AFL were statistically non-significant indicating no improvement in the trait over the period of study and lack of directional selection for the trait.

Estimates of environmental trends (Table 1) were negative in magnitude for all studied traits except for W12. In general, estimates for environmental trends for body weight traits, though statistically non-significant, were having negative directions indicating that in spite of presence of relatively positive genetic trends and selecting elite rams in each generation, the desired results were not obtained in the breeding programme. Year to year fluctuation of the rainfall, temperature, and quality of the feed and fodder resources, managerial skills, work culture and above all different managemental practices during the course of study contributed heavily for the negative environmental trends in the performance traits of this flock of sheep. All the efforts towards improving the flock as a good quality dual type sheep did not bring the desired results in growth traits due to negative impact of the environment on the production potential of the animals. Though it is not possible to control climatic variable but through consistent good managemental practices over the years, animals can be insulated to a large extent from negative impact of environment which may eventually lead to enhanced performance of the flock and consistent trends in production traits and this gain can be further multiplied in field as the farm is nucleus of Corriedale breeding stock.

Positive and statistically significant (P≤0.01) genetic trends were recorded for all studied body weight traits whereas for AFL it was non-significant. Phenotypic trends for all the traits under study were statistically non-significant. Positive breeding value trends are indicator of effective selection and it may therefore be inferred that effective selection has taken place for the traits under study. Further improvement in the breed may however be possible through rigorous selection while keeping inbreeding under check through ONBS.

## REFERENCES

Arora A L, Gowane G R, Prince L L L and Ved P. 2010. Genetic trends for performance traits of Malpura sheep. *Indian Journal of Animal Sciences* **80**(9): 937–39

El-Wakil S I and Elsayed M. 2013. Genetic, phenotypic and environmental trends towards improving body weight in Barki sheep. *Egyptian Journal of Sheep and Goat Sciences* **2**(8): 11–20.

Hamadani A, Ganai N A, Khan N N, Shanaz S and Ahmad T. 2019. Estimation of genetic, heritability, and phenotypic trends for weight and wool traits in Rambouillet sheep. *Small Ruminant Research* **177**(2019): 133–40

Harville D A and Hendeason C R. 1966. *Environmental and genetic trends in production and their effect on sire evaluation*. Department of Animal Husbandry Cornell University, Ithaca, New York.

Henderson C R, 1975. Best linear unbiased estimation and prediction under a selection model. *Biometrics* **31**: 423–47.

Lax J, Chapman A B, Pope A L, Baker R L and Bradley B P. 1979. Comparison of single trait and index selection in sheep. *Journal of Animal Science* **48**: 776–88.

Mokhtari M S and Rashidi A. 2010. Genetic trends estimation for body weights of Kermani sheep at different ages using multi-variate animal models. *Small Ruminant Research* **88**: 23–26.

Rather M A, Shanaz S, Ganai N A, Bukhari S, Hamadani A, Khan N N, Yousuf S, Baba A, Raja T A and Khan H M. 2019. Genetic evaluation of wool traits of Kashmir Merino sheep in organized farms. *Small Ruminant Research* **177**(2019): 14–17.

Shaat I, Galal S and Mansour H. 2004. Genetic trends for lamb weights in flocks of Egyptian Rahmani and Ossimi sheep. *Small Ruminant Research* **51**: 23–28.

Shrestha J N B, Peters H F, Heaney, D P and Van Vleck L D. 1996. Genetic trends over 20 years of selection in three synthetic Arcotts, Suffolk and Finnish Landrace sheep breeds for early growth traits. *Canadian Journal of Animal Science* **76**: 23–34.

Singh G and Dhillon J S. 1992. Estimation of genetic trends in a closed flock of Avivastra sheep. *Indian Journal of Animal Sciences* **61**: 617–19.