# ENVIRONMENTAL FACTORS AFFECTING PRE-WEANING GROWTH TRAITS OF HISSARDALE SHEEP IN PAKISTAN

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## ABSTRACT

Performance data on Hissardale sheep maintained at Livestock Experiment Station, Jahangirabad, district Khanewal, during 1978-95 were analysed using Harvey's Mixed Model Least Squares and Maximum Likelihood computer programme. The objective was to evaluate the pre weaning growth performance of Hissardale sheep in Pakistan. The average birth weight was 4.0±0.51 kg which was significantly affected by year, season, type of birth, sex and age of the dam (P<0.01). The average 60- and 90-day weights were 11.5±2.13 and 15.5±3.06 kg, respectively, which were significantly affected by year of birth, type of birth and sex (P<0.01). The weaning weight of Hissardale lambs averaged 20.1±3.86 kg and was affected significantly by year of birth, season of birth and sex of the lamb (P<0.01). The effect of type of birth of the lamb and age of the dam on weaning weight was, however, non significant (*P*>0.05).

**Key Words**: Hissardale sheep, Pre-weaning growth, Environmental factors.

## INTRODUCTION

Pakistan supports about 30 million heads of sheep which are a source of earning livelihood for thousands of farmers particularly in the arid and semi arid zones of the country. These animals provide 875 thousand tonnes of mutton providing about 47 percent of the total mutton produced in the country (Anonymous, 1995). The wool from almost all the breeds of sheep in Pakistan is of carpet quality. The annual production of wool is estimated to be 53.1 thousand tonnes, out of which over one thousand tonnes of raw carpet wool amounting to Rs. 100 million is exported. The export of carpets earns foreign exchange worth more than Rs. 4 billion. However, the country had been spending foreign exchange worth Rs. 7 million on the import of fine wool required by the local industry for the manufacture of apparel cloth (FAO, 1992).

Hissardale is a fine wool breed of sheep developed at Hissar, British India, during 1930. This breed contains 7/8 Merino and 1/8 Bikaneri inheritance. This breed has the potential to cater the requirements of fine wool for the manufacture of apparel cloth by the woolen mills. In view of the future prospects of Hissardale sheep for the production of fine wool in Pakistan, efforts are needed for the propagation and conservation of this breed in the country.

The performance of an animal is affected by the environmental factors as well as the genetic make up and the identification of genetically superior individuals necessitates the evaluation of all known environmental factors. This is needed for the formulation of effective breeding plans to improve the breed. The growth rate in the preweaning period is important to attain higher weaning weights and thus higher weights at market age. The preweaning growth traits in sheep include birth weight, 60-day weight, 90-day weight and weaning weight. There is a general dearth of information on the evaluation of environmental factors affecting various performance traits of Hissardale sheep in Pakistan. The present study was thus planned to estimate various environmental factors influencing pre weaning growth traits of animals of this breed.

## MATERIALS AND METHODS

Performance data on Hissardale sheep kept at the Livestock Experiment Station, Jahangirabad, district Khanewal, Pakistan collected during 1978-1995 were used in the present study. The following information was collected: Individual's identity, Date of birth, Birth weight, Sex of the lamb, Body weights at 60, 90, 120 days, Sire, Date of weaning and Type of birth.

The performance traits examined in the present investigation included i) Birth weight, ii) 60-day weight, iii) 90-day weight and iv) Weaning weight (120-day). Generally, the ewes were bred once a year in autumn (September-October) and lambs were born during subsequent spring (February-March). Most of the ewes (87 percent) lambed during spring season while rest of the

ewes which were not bred during autumn season were mated in the subsequent spring season to lamb during the Autumn season. The animals were shorn twice a year i.e., spring and autumn.

Prior to data analyses several edits were performed to remove the outlyers. Following edit criteria were used: 2.0 kg ≤ Birth weight ≤ 5.5 kg; 10 kg ≤ Weaning weight ≤ 30 kg; 75 days ≤ Weaning age ≤ 150 days. Data with any recorded abnormality were excluded from the analyses. Data on various pre-weaning growth traits were analyzed to evaluate the influence of different environmental sources of variation (e.g., sex of the lamb born, type of birth, age of the ewe at lambing, year and season of birth). For each trait, different statistical model was assumed by incorporating the appropriate environmental factors in the analysis of variance (Akhtar, 1996). Theoretical description of model assumed for birth weight for example, is given in the following:

Each observed value of the trait was assumed to follow the following statistical Model:

$$Y_{ijklmn} = \mu + (Year)_i + (Season)_j + (Age)_k + (BT)_l + (Sex)_m + (Age*BT)_{kl} + (BT*Sex)_{lm} + \varepsilon_{ijklmn}$$

Where,

$Y_{ijklmn}$ = birth weight of nth lamb (n=1,...4777) of mth sex ($Sex_m$, m = 1, male; 2, female); of lth birth type ($Bt_l$, l =1, single;2, twin) and kth age of dam group ($Age_k$, k=1, young i.e.<3.5 years; 2, mature i.e.3.5 to 5.5 years; 3, old i.e. >5.5 years) and born during jth season ($S_j$, j=1, spring; 2, autumn) in ith year of birth ($Year_i$, i=1,2,3 ...18);

$\mu$ = Population mean;

$(Age*BT)_{kl}$ = effect of interaction between kth age of the ewe group and lth birth type on $Y_{ijklmn}$;

$(BT*Sex)_{lm}$ = effect of interaction between lth birth type and mth sex of the lamb on Yijklmn;

$\varepsilon ijklmn$ = random error. It was assumed that $\varepsilon ijklmn$ was normally and independently distributed with mean zero and variance $\varepsilon 2e$.

The standard weaning age was assumed as 120 days. Since the lambs varied in their ages at weaning, weight was adjusted to 120 days by the following formula (Akhtar, 1996):

$$\text{Adjusted 120-day weaning weight} = \frac{\text{Actual weaning weight - Birth weight}}{\text{Actual weaning age in days}} * 120 + \text{Birth weight}$$

The records of other body weights were adjusted to any age simply by substituting the desired age for 120 in the above formula. These adjusted body weights were subjected to analysis of variance for estimation of the magnitude of environmental factors. The Mixed Model Least Squares and Maximum Likelihood Computer Program (Harvey, 1990) was used for the evaluation of the influence of various environmental factors on the pre-weaning growth traits.

## RESULTS AND DISCUSSION

Data on 4777 lambings of Hissardale ewes kept at the Livestock Experiment Station Jehangirabad, district Khanewal, (Pakistan) spread over a period of 15 years were used to evaluate the magnitude of various environmental sources of variation in different pre-weaning growth traits in this flock. The twining rate in this flock was 19 percent. The sex ratio was 52.5: 47.5 males and females, respectively. The birth, 60-days, 90-days and weaning weights in this flock averaged 4.0±0.51,11.50±2.13, 15.50±3.06 and 20.10±3.86 kg, respectively (Table 1).

Table 1: Mean values of some performance traits in Hissardale lambs.

| Trait | Number | Mean | S.D. |
|---|---|---|---|
| Birth weight (kg) | 4777 | 4.0 | 0.51 |
| 60-day weight (kg) | 4278 | 11.5 | 2.13 |
| 90-day weight (kg) | 4278 | 15.5 | 3.06 |
| Weaning weight (kg) | 4278 | 20.1 | 3.86 |

**Birth Weight**

The analysis of variance for the evaluation of the influence of year, season, type of birth, sex of the lamb and age of the dam on birth weight was carried out. It was observed that birth weight varied significantly due to year, season and type of birth, sex of the lambs and age of the dam (P<0.01). The least squares means for birth weight of lambs during different seasons and for age of dam, birth type and sex are given in Table 2. The least squares means for birth weight varied widely during different years; the value was 3.4±0.04 kg during 1981 and showed an increasing trend upto 1991, except during 1986, when it decreased. Following 1991, the birth weight decreased during subsequent two years, touched its peak of 4.1±0.03kg during 1994 and again decreased slightly during 1995. The lambs born during spring were heavier (3.8±0.01kg) than those born during autumn season (3.6±0.02kg). Similarly, single born lambs were heavier than twin born lambs (3.9±0.14 VS 3.5±0.03 kg), and the male lambs were heavier (3.9±0.02 kg) than the female lambs (3.5±0.02kg) (Table 2). The young ewes produced lighter lambs at birth (3.5±0.02kg) as compared to mature ewes (4.0±0.02kg). Lambs from the old ewes

had almost similar birth weight (3.6±0.03kg) as those from the young ewes.

Table 2: Least squares means and standard errors of birth weight for various groups of lambs.

| Independent Variable | Number of Observation | L. S. Means ± S.E. |
|---|---|---|
| **Season of birth(SOB)** | | |
| Spring | 4128 | 3.8±0.01 |
| Autumn | 649 | 3.6±0.02 |
| **Sex of lamb** | | |
| Male | 2509 | 3.9±0.02 |
| Female | 2268 | 3.5±0.02 |
| **Birth Type** | | |
| Single | 3866 | 3.9±0.04 |
| Twin | 911 | 3.5±0.03 |
| **Age of Dam** | | |
| Young | 1430 | 3.5±0.02 |
| Mature | 2388 | 4.0±0.02 |
| Old | 959 | 3.6±0.03 |

The significant influence of year and season of birth, sex of the lamb, birth type and age of dam on birth weight of lambs observed in the present study is in agreement with many workers (Combellas *et al.*, 1980; Garcia *et al.*, 1984; Cho *et al.*, 1989; Wojtowski *et al.*, 1990; Khan *et al.*, 1991; Samkova *et al.*, 1992; Fanlo *et al.*, 1994; Babar, 1994).Combellas *et al.* (1980) studied the factors affecting birth weight of lambs in West African and Black-headed Persian breeds of sheep. It was found that the birth weight averaged 2.33 and 2.41kg in the two breeds, respectively. The birth weight was also reported to be significantly affected by sex, year and birth type.

The birth weight of lambs also varied with sex and type of birth ($P<0.01$). Single born lambs were heavier than the multiple born lambs as they had better opportunities in the uterus of their dams as compared to multiple lambs. Similarly, the male lambs were heavier at birth as the gestation period of ewes carrying male lambs was slightly longer (1-2 days) than those carrying female lambs (Babar, 1994). Turner and Young (1969) pointed out that the internal factors including the animal's sex, maternal effects like age of dam and type of birth affected the production of the individual animals. Numerous reports in literature also indicated that the single born lambs, as well as the male lambs, were heavier than multiple births and females (Combellas *et al.*, 1980; Wojtowski *et al.*, 1990; Mokhtar *et al.*, 1991; Fanlo *et al.*, 1994; Babar 1994).

The age of the dam also had significant effect on the birth weight of the lambs. Young and very old ewes tended to produce lighter lambs as compared to ewes between 3 and 6 years of age. Higher birth weight of lambs from the mature ewes may be attributed to the large size of the uterus in mature ewes. After attaining full growth and development in mature ewes could spare some of their energies for the better nourishment of lambs in their uterus. However, very old ewes due to their worn out teeth could perhaps not utilize the feed properly, resulting in the birth of lighter lambs.

The variation of birth weight in lambs in different years reflected the level of management, some environmental effects like temperature and humidity and the availability of good quality feed in sufficient quantity. The level of management can vary according to the ability of the farm manager, his system of crop husbandry, methods and intensity of culling and his efficiency in the supervision of the farm labour as well as availability of financial resources (Basu and Ghai, 1981). The farm under study was resumed by the Government of Punjab during 1974 and remained under the control of Punjab Livestock Board. However, during 1977 the farm was raised to the status of Livestock Experiment Station under the Directorate of Livestock Farms Punjab. Since during early period, the animals were mainly fed on green fodder and roughages, the fluctuation in quantity of forages resulting from variability in available irrigation or by the rain fall might have affected the birth weights during 1981-87. Well selected and properly fed ewes commonly produced heavy lambs at birth, which is indicated by the production of heavy lambs from 1988 to 1991.

The maximum lambing in the flock (86.4 %) was recorded in spring season while only 13.6 percent lambs were born during autumn season. This reflects the seasonality of breeding in Hissardale sheep under Pakistan climatic conditions. It also explains about the heavier lambs at birth during spring than autumn season. As a result of rains during July and August, green fodder/grasses during breeding season were available in ample quantity for the ewes. Although the animals had to face a scarcity of green fodder during early winter, the availability of green fodder, particularly Berseem *(Trifolium alexandrium)* and Oats *(Avena sativa)*, during January and February provided good quality fodder to the ewes. On the other hand, ewes lambing during autumn almost had the whole duration of their pregnancy during summer months. It has also been indicated that high air temperature had an adverse effect upon pregnant ewes resulting in low birth weight of the lambs. High temperature during this period might have also affected the feed intake thus adversely affecting the productivity of Hissardale ewes having 87.5 percent exotic inheritance from Merino breed.

**Weight at 60 and 90 days of age**

The analysis of variance for the evaluation of the influence of different environmental factors on weight at 60 and 90 days revealed that the weight at 60 and 90 days varied significantly due to year of birth($P<0.01$), type of birth ($P<0.05$) and lamb sex ($P<0.01$). However, the differences in weight of lambs at 60 and 90 days due to season of birth and age of dam were non significant. The single born and male lambs were heavier than the twins female lambs groups. The least squares means and the standard error's for the weights at 60 and 90 days of age of lambs born in different seasons and for age of the dam, birth type and sex are given in Table 3.

Table 3: Least squares means and the standard errors of 60 and 90 days weight of Hissardale lambs of various groups

| Independent Variable | Number of obs. | 60-day weight | 90-day weight |
|---|---|---|---|
| | | L. S. Means ± S.E. | L. S. Means ± S.E. |
| **Season of birth** | | | |
| Spring | 3775 | 11.4±0.06 | 15.4±0.08 |
| Autumn | 503 | 11.4±0.11 | 15.3±0.16 |
| **Sex of lamb** | | | |
| Male | 2264 | 11.6±0.08 | 16.2±0.16 |
| Female | 2014 | 11.2±0.08 | 14.6±0.12 |
| **Birth Type** | | | |
| Single | 3435 | 11.5±0.06 | 15.5±0.09 |
| Twin | 843 | 11.3±0.09 | 15.2±0.14 |
| **Age of the dam** | | | |
| Young | 1255 | 11.4±0.21 | 15.5±0.29 |
| Mature | 2166 | 11.4±0.11 | 15.4±0.15 |
| Old | 857 | 11.5±0.09 | 15.3±0.13 |

**Weaning weight**

The analysis of variance revealed significant effect of year and season of birth and sex of lamb ($P<0.01$) on weaning weight. However, the differences in weaning weight of the lambs due to type of birth and age of the dam were non significant. The least squares means and the standard errors for weaning weight of lambs during different season and for age of the dam, birth type and sex are given in Table 4. The data revealed that the spring born lambs were heavier (19.9±0.10kg) than those autumn born lambs (19.2±0.20kg). Similarly, the male lambs were heavier at weaning than the females.

The average weaning weight of Hissardale lambs (20.12±3.86kg) recorded in the present study is higher than most of the breeds of sheep which were having lesser than 15kg weaning weight (Combellas et al., 1980; Singh et al., 1987).However, the weaning weight in the present flock is lower than many breeds of sheep including Suffolk, Polish Merino, Corriedale and Awassi which ranged from 25 to 28 kg at weaning (Garcia et al., 1984 and Nawaz et al., 1985).

Table 4: Least squares means and standard errors of weaning weight of Hissardale lambs of various groups.

| Independent Variable | Number of observation | L.S. Means ± S.E. |
|---|---|---|
| **Season of birth** | | |
| Spring | 3775 | 19.9±0.10 |
| Autumn | 503 | 19.2±0.20 |
| **Sex of lamb** | | |
| Male | 2264 | 20.4±0.15 |
| Female | 2014 | 18.7±0.15 |
| **Birth Type** | | |
| Single | 3435 | 19.7±0.12 |
| Twin | 843 | 19.4±0.17 |
| **Age of the dam** | | |
| Young | 1255 | 19.6±0.37 |
| Mature | 2166 | 19.7±0.20 |
| Old | 857 | 19.4±0.17 |

The wide variation in the weaning weight of Hissardale lambs during different years ($P<0.01$) is in line with the findings of many workers (Nawaz *et al.*, 1985; Sheikh *et al.*, 1986; Cho *et al.*, 1989; Burfening & Carpio, 1993; Babar, 1994). Similarly, the significant effect of season and sex on weaning weight observed in the present study is also in line with the findings of many workers (Garcia *et al.*, 1984; Carrillo and Segura, 1993; Babar, 1994). Mokhtar *et al.* (1991) studied the effect of sex of the lamb and season on weaning weight of Barki lambs and reported that the weaning weight was significantly influenced by these factors.

## REFERENCES

Akhtar, P., 1996. Genetic and Phenotypic parameters of some performance characteristics of Hissardale Sheep in Pakistan. Ph. D. Thesis, Univ. Agric., Faisalabad Pakistan.

Anonymous., 1995. Economic Survey, Govt. of Pakistan, Finance Division, Economic Advisor's Wing, Islamabad.

Babar, M. E. 1994. Genetic and Phenotypic parameters of some performance characteristics of Lohi Sheep. Ph. D. Thesis, Univ. Agric., Faisalabad Pakistan.

Basu, S. B. and A. S. Ghai, 1981. Genetic and non genetic sources of variation in dry period of Murrah buffaloes. Indian J. Anim. Sci., 51: 150-152.

Burfening, P. J. and M. P. Carpio., 1993. Genetic and environmental factors affecting growth rate and survival of Junin sheep in the central highlands of Peru. Small Rumin. Res., 11: 275-287.

Carrillo, L. and J. C. Segura, 1993. Environmental and Genetic effects on pre-weaning growth performance of Lair sheep in Mexico. Trop. Anim. Hlth. Prod., 25:173-178.

Cho, H. C., D. J. Kang, K. S. Choi, D. K. Oh and Y. J. Kim, 1989. The effects of some environmental factors on growth and wool production in sheep. 3. Weights at birth, weaning and 18 months. Korean J. Anim. Sci., 31 (11). 677-683.

Combellas, J. D., N. Martinez and J. E. Gonzalez, 1980. A study of some factors affecting birth and weaning weights of lambs. In informe Annual, Instituto de Production Animal. Maracay, Venezuela; Universidad Central de Venezuela, 72-73.

Fanlo, R., J. Estany and A. Ferret, 1994. Growth traits in Ripollesa lambs. ITEA, produccion Animal, 90A: 15-27.

FAO, 1992. Year Book, Trade, Food and Agriculture Organization of the United Nations, Rome.

Garcia, F. X., M. P. Perez and D. Rodriguez, 1984. Environmental and genetic effects on sheep. In Investigaciones del Departmento de produccion Animal, 1981-82. Santiago, Chile; Universidad de Chile, 131-133.

Harvey, W. R., 1990. User's Guide for LSMLMW (PC version) Mixed model Least squares and maximum Likelihood Computer Program, Ohio State University, Ohio, U. S. A.

Khan, M. A., L. A. Akhter, G. M. Din and G. R. Khan, 1991. Environmental factors influencing some production traits of Awassi sheep in Pakistan. Sarhad J. Agri., 7:329-335

Mokhtar, M. M., H. Mansour, A. A. Younis and H. El-Grabbas, 1991. Growth and mature size in fat tailed sheep. Egyptian J. Anim. Prod., 28:39-46.

Nawaz, M., M. D. Ahmad, Z. Ahmad, G. R. Khan and M. A. Khan, 1985. Comparative performance of Awassi, Kachhi and crossbred (Kachhi x Awassi) lambs. Pakistan J. Agri. Sci., 22: 181-187.

Samkova, E., R. Kalous and M. Kral, 1992. Growth of Sumava lambs in relation to sex and litter size. Zootechnica Rada, 9:55-66.

Shiekh, N. A., J. S. Dhillon and O. S. Parmar, 1986. Genetic evaluation of a flock of Kashmir Merino sheep. I. Body weights. Indian J. Anim. Sci., 56: 244-247.

Singh, G., B. S. Mehta, I. C. Sethi and C. L. Arora, 1987. Genetic and non-genetic factors affecting growth traits of Nali and its crossbred lambs under semi-arid conditions. Indian J. Anim. Sci., 57: 728-734.

Turner, H. N. and S. S. Y. Young, 1969. Quantitative Genetics in Sheep Breeding. Cornell Univ. Press, Ithaca, New York, USA.

Wojtowski, J., A. Sonne and R. Wassmuth., 1990. Genetic and non genetic effects on growth of Merino landschaf and Rhon sheep. Zuchtungskunde, 62 (3):234-240.