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IDENTIFICATION OF ENVIRONMENTAL FACTORS AFFECTING PRE WEANING PERFORMANCE OF MENGALI SHEEP OF BALOCHISTAN

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ABSTRACT

The objectives of the present study were to analyze different environmental factors affecting pre-weaning growth performance of Mengali sheep. Performance records on 2377 lambs in four flocks maintained at Experimental Station, Centre for Advanced Studies in Vaccinology and Biotechnology, Quetta (ESC), Mastung, Nushki and Quetta area over a period of 5 years (Jan 2005 to Dec 2009) were analysed. Body weights at birth (BW), 30 days (1MW), 60 days (2MW), 90 days (3MW), 120 days Weaning weight, (WW), and pre-weaning average daily gain (PRADG) were evaluated. Location of flock, year of birth (YOB), season of birth (SOB), type of birth (TOB), sex and their interactions were the fixed effects in the model. The overall average values for BW, 1MW, 2MW, 3MW, WW, and PRADG were found as 3.54±0.37, 7.96±0.91, 11.77±1.83, 15.51±2.86, 19.16±3.23 kg, and 135.00±0.26 g, respectively. Location of flock, sex, and TOB had significant influences ($P<0.05$) on weights at all ages. However, YOB*SOB and TOB*sex had non significant effects ($P>0.05$) on weights at all ages. Flock kept at ESC (Quetta) location showed better performance for all traits as compared to other flocks. The difference might be attributed to regular supplementation of ration to this flock. Male lambs were heavier than female lambs, and single born lambs were also significantly heavier than twins ($P<0.05$) at birth. Results reflected that Mengali breed can be improved through selection and better management.

Key words: Pre-weaning growth traits, non-genetic factors, fixed effect model, Mengali sheep.

INTRODUCTION

Sheep breeding is an important enterprise in animal production yielding foods such as meat and milk which are very important for people's nourishment all over the world (Eyduran *et al.*, 2009). Small ruminants have high adoptability to adjust in extreme climatic conditions. Sheep rearing has particularly played a vital role in the improvement of rural financial system. In the event of failures of seasonal rains, it is well-known that the rearing of sheep provides a significant contribution notably to the farmers at the time of crisis due to crop failure. Therefore, sheep is expressed as, "finance elevator" by the countryside poor farmer (Sharif *et al.*, 2011). Small ruminants being the largest users of rangeland have proven themselves as remarkable converters of roughages/forages and agriculture by-products into economically substantial products such as milk, meat and wool (Khan, 1994). Sheep rearing in Balochistan province is closely linked with grazing by adopting transhumant production system. The ruminants are markedly dependent on natural pasture and fibrous crop/orchard residues for their survival, growth, reproduction and production. It is likely to obtain optimum growth with appropriate combination of concentrate and forage in the animals' ration (Mahgoub *et al.,* 2000: Achakzai, 2005). Munir *et al.* (2007) also mentioned that winter is severe predominantly for small ruminants raised extensively in Balochistan region. This situation restricts animal production in terms of nutrition, growth rate, reproduction, disease incidence and marketing.

The environmental sources of variation can be classified into two groups (internal and external). As for as the external environmental factors are concerned, these includes the region where sheep farming is practiced, which covers all features of environment, climatic conditions and seasonal variation varying from year to year. All the above mentioned factors have a respectable effect on the whole flock's level of production. The widely known factors such as sex of the animal, maternal effects (dam's age and birth type), animal's own age in years and reproductive status of the animal are among internal factors, significantly influencing the performance of individual animal (Turner and Young, 1969). Growth, one of the most essential traits in farm animals, is defined as an increase in tissues and organs of the animals per unit time and affected by genetic and environmental factors (Tariq *et al.*, 2011). There is lack of information on the sheep breeding in Balochistan especially on Mengali sheep breed. Hence, the present study was undertaken to highlight the effect of some non-genetic/environmental factors on the pre-weaning production performance of the indigenous Mengali sheep.

MATERIALS AND METHODS

The pedigree and performance data on Mengali sheep of Balochistan recorded on 2377 lambs descended from 581 ewes and 56 rams in four flocks at three different locations were available for the present study. The data were collected for different periods in these flocks. Data on three sheep flocks maintained at Mastung (Khadkocha), Nushki (Peer Wala) and Quetta (Killi Hassni) of progressive farmers were collected from Jan 2005 to Dec 2009, and data on fourth flock kept at Experimental station at Centre for Advanced Studies in Vaccinology and Biotechnology (CASVAB) (ESC), University of Balochistan (UoB) Brewery Road, Quetta were recorded from Jan 2006 to Dec 2009. Information about individual's identity, sire ID, dam ID, dam's date of birth, date of lambing, sex of the lamb, type of birth (TOB), season of birth (SOB), and year of birth (YOB) were also recorded. The performance traits included birth weight (BW) and weights at 30 days (MW), 60 days (2MW) 90 days (3MW) 120 days, weaning weight, (WW) and pre-weaning average daily gain (PRADG). The data were statistically analyzed to evaluate the influence of various environmental factors (non-genetic sources of variation) such as year and season of lambing, sex of the lamb, type of birth, and age of the ewe at lambing. Analytical models were similar to those of other indigenous sheep breeds in Pakistan viz Lohi (Babar, 1994); Hissardale (Akhtar, 1996); Kajli (Qureshi, 1996) and Thalli (Hussain, 2006). Only normal and complete records were considered for all the statistical analyses. The records from stillbirths or premature births were excluded from the study. All interaction between traits and age of ewe at lambing were removed from the final model being non-significant.

Following fixed effect models were assumed: Model I for birth and weaning weight while Model II for other traits.

$$Y_{ijklmn} = \mu + F_i + YOB_j + SOB_k + TOB_l + SEX_m + b(P_{ijklmn}) + e_{ijklmn} \quad \text{(Model I)}$$

$$Y_{ijklmn} = \mu + F_i + YOB_j + SOB_k + TOB_l + SEX_m + e_{ijklmn} \quad \text{(Model II)}$$

Where; Y_{ijklm} = Trait of interest observed; μ = Population mean; F_{i} = Effect of the flock (1-4); YOB_j = Year of birth; SOB_k = Season of birth (Spring, Autumn); TOB_l = Type of birth(Single, twin); SEX_m = Male and female; b= regression coefficient; P_{ijklmn} = maternal effect of dam, e_{ijklmn} = random error associated with each observation. It is assumed to be normally distributed with mean zero and variance $_{e.}2$ MS Excel spreadsheet was used for entering and editing of data and making comma delimited files. Statistical package for Social Sciences (SPSS) was used for descriptive statistics. The ASREML (Version 2.0) was also used for other analysis (Gilmour *et al.*, 2007).

RESULTS AND DISCUSSION

Data on 2377 lambings of Mengali ewes kept in four sheep farms (flocks) at three different locations of Balochistan spread over period of 5 years were collected for evaluating the effect of various environmental sources of variation on different pre-weaning performance traits. The twining and lambing rate were 4.30 and 85 percent, respectively, whereas secondary sex ratio (male: female) was observed to be 49.37:50.63. The overall means values for BW, 1MW, 2MW, 3MW, WW, and PRADG, were 3.54±0.37, 7.96±0.91, 11.77±1.83, 15.51±2.86, 19.16±3.23 kg and 135.00±0.26 g, respectively (Table 1). Environmental factors such as location of flock, sex, and TOB had significant effects ($P<0.05$) on weights at all ages except for TOB that did not affect PRADG significantly. On the other hand, YOB*SOB and TOB*sex were found to be non-significant ($P>0.05$) for weights for all the ages. Flock kept at ESC (Quetta) location performed significantly ($P<0.05$) better in all traits when compared to other flocks (Table 2). This difference might be due to regular supplementation of ration to this flock. Birth weight of the male lambs were heavier than those of female lambs, and single born lambs were also significantly heavier than twins ($P<0.05$), as expected.

Birth Weight (BW): The least squares means and the standard errors (LSM±SE) for BW for Mengali lambs were observed in male (n=1174) as 3.61±0.36, female (n=1203) 3.48±0.37 and combined (n=2377) 3.54±0.36 kg. The means observed for BW varied widely from year to year. The lambs born during spring season were heavier (3.68±0.35 kg) than the lambs born during autumn season (3.49±0.33 kg). Similarly, single born lambs were (3.72±0.29 kg) heavier than twin born lambs (3.45±0.34 kg). The ANOVA showed that BW of lambs varied significantly ($P<0.05$) due to location, YOB, SOB, TOB and sex. However, the difference in BW of lambs due to YOB*SOB and TOB*sex was insignificant ($P>0.05$) (Table 2). Maternal effects were also not significant for BW in this breed. The heavier body weight of male lambs compared to female lambs may be due to variation in their endocrine profile and in their culling level practiced at different ages. Lower body weight of twins lambs when compared to single may be due to limited uterine space and inadequate availability of nutrients during pregnancy and competition between the twins for limited quantity of milk available from the dam. The physiological compensatory mechanism may have played its role in influencing the faster growth rate to overcome the handicap during the pre-weaning period for achieving the physical and physiological maturity at the same time. Rather than age of dam, body weight of dam had played a greater role in influencing lamb weights (Babar, 1994; Dixit *et al.*, 2001).

The variation of BW in lambs in different years reflected the level of management, some environmental effects like climatic conditions and availability of good quality feed in sufficient quantity. Well selected and proper fed ewes commonly produced heavy lambs at birth; similar, findings were documented by Akhtar *et al.* (2001). The significant effect of YOB, TOB, SOB and sex on BW of lambs in the present study was in line with the findings of many researchers (Akhtar *et al.,* 2001; Abegaz *et al.,* 2002; Matika *et al.,* 2003; Babar *et al.*, 2004; Shah and Khan, 2004; Hussain, 2006; Refiq *et al.*, 2009; Mokhtari and Rashidi, 2010; Akhtar *et al.*, 2012). Akhtar *et al.* (2001) analyzed performance data on 4777 Hissardale lambs during the period of 1978-95 and reported average values for birth (4.0±0.51 kg). They further stated that the lambs born during spring were heavier (3.8±0.01 kg) compared with the lambs born during autumn season (3.6±0.02 kg). Similarly, single born lambs were found to be heavier than twin born lambs (3.9±0.14 vs. 3.5±0.03 kg). Additionally, male lambs were also heavier (3.9±0.02 kg) than the female lambs (3.5±0.02 kg). They also revealed that, year of birth, type of birth and sex statistically affected birth weight (P<0.01). Abegaz *et al.* (2002) studied factors affecting the early growth and survival of indigenous Ethiopian Horro sheep with 4031 lambs from 1978-97 and reported that, YOB, TOB and sex or rearing were major factors appreciably influencing (P<0.01) birth weight. Male lambs were heavier by 0.14 kg than females in birth weight. Single-born lambs were heavier by about 0.5 kg than multiple-born lambs at birth. Hussain (2006) recorded in Thalli sheep that, the lambs born during spring season were slightly heavier (4.05±0.12 kg) than those born during autumn season (4.01±0.06 kg). While, the average weight of single-lambs (4.24±0.00 kg) was observed heavier than the average weight of twin lambs (3.68±0.01 kg). Similarly, the male lambs were also heavier than females. Averages of birth weight for male and female lambs were found as: 4.21±0.10 and 3.85±0.08 kg, respectively. The author also learned that, YOB, TOB (P<0.01) and sex (P<0.05) were environmental factors that crucially influenced birth weight while, SOB was found to be an insignificant effect. Refiq *et al*. (2009) and Mokhtari and Rashidi, (2010), also revealed that SOB and sex were significantly effective factors on birth weight and birth weight of spring-born lambs was statistically heavier than autumn born lambs, matched with findings of the present study. The birth weight of lambs illustrated variation significantly with type of birth, season of birth and sex of the lamb born because lambs born as single having better opportunities in the dam's uterus than the multiple births. Male lambs were heavier than female that was due to the reason the gestation period for male lambs was slightly longer (1-2 days) compared to female (Mokhtari and Rashidi, 2010).

The differences among different reports may be due to breed, size of the data set or method of estimation used in different studies, production system, climatic conditions and ecological zones, where sheep farming were practiced. This wide variation in birth weight indicated that mass selection for higher birth weight could be performed with aim of improving the birth weight of lambs so that early lamb mortality may be reduced.

Weight at 30 days: The LSM+SE for 1MW are shown in Table 1. This trait was significantly affected by location of flock, SOB, TOB, Sex and maternal effects of dam. On the other hand year of birth, and its interaction with season showed no affect on this trait. Also TOB*Sex did not affect IMW significantly (P>0.05).

Weights at 60 Days (2MW) and 90 days (3MW): The overall LSM±SE values for weight at 60 days of age for male, female and combined lambs were 12.25±1.89 11.31±1.86 and 11.77±1.93 kg, respectively. The overall LSM±SE values for 2MW fluctuated notably during different years. The highest mean for 2MW in male lambs was 12.88±1.53 in year 2009 while the lowest one was recorded as 11.51±2.13 in the year 2005**.** ANOVA for the evaluation of the influence of different environmental factors on weight at 2 MW obviously reflected that the weight at 2 MW varied significantly due to YOB, TOB and sex (P<0.05) of lambs. However, no statistical difference was observed for SOB and TOB*sex (Table 2). The overall LSM (±SE) for weight at 90 days for, male, female and combined sex were 16.25±2.62, 14.80±2.91 and 15.51±2.86 kg, respectively.

Result of the present study supported the findings of Akhtar (1996). However, the difference in weight at 60 days and 90 days of lambs due to YOB*sex was significant, which was contrary to the present study. Hussain (2006) recorded data of 10377 lambs from 1978-97 and reported that average values for 60 days weights were 11.89±0.39 for female lambs (n=5743) and 12.95±0.46 for male lambs (n =5488). The investigator partially agreed with the results given in the present study. ANOVA showed that the influence of YOB, TOB and sex had significant effect at 60 days weight, but TOB*sex was insignificant, which were in line with the results of the present study. SOB showed a significant effect for weight at 60 days which was not similar to the present study (Hussain, 2006).

The results of the present study for 90 days weight were in the line with finding of Hussain (2006), who reported average value for 90 days weight in combined sex (male and female) 14.92±4.56. Analysis of variance showed that the influence of YOB, SOB had significant effect on 90 days weight while TOB*sex was insignificant; these findings were similar to the results of the present study.

Weaning Weight (WW): The averages for WW were 20.33 ±3.30; 18.04±3.35 and 19.16±3.23 for Male, female and combined sexes, respectively in present study. The data also revealed that the spring born lambs at WW were heavier (19.95±3.39 kg) as compared to autumn born lambs (18.54±3.30 kg). Similarly, single born lambs were (20.15±3.10 kg) heavier than twin born lambs (18.45±3.00 kg). Maternal effects did not show any significant variation for WW. The results of the present study were in agreement with the findings of many investigators (Abegaz *et al.*, 2002; Akhtar *et al.*, 2001; Esenbuga and Dayioglu, 2002; Matika *et al*. 2003; Babar *et al.*, 2004; Shah and Khan 2004; Hussain, 2006; Refiq *et al.*, 2009; Mokhtari and Rashidi, 2010). Refiq *et al*. (2009) studied the effect of YOB, SOB, TOB, and sex on weaning weight of Turkish Merino lambs and reported that, the weaning weight was significantly influenced by YOB, SOB, TOB, and sex (P<0.05). Mokhtari and Rashidi, (2010), who studied the effects of some environmental factors on growth traits of Kermani lambs, reported that, the year, season of birth, sex and type of birth had highly significant (P<0.01) on weaning weight. Weaning weight of the lamb indicates the mothering ability of dam and the growth potential inherited by the lamb. The significant difference of type of birth on weaning weight as obtained in present study was not in agreement with the findings of Akhtar *et al*. (2001). They reported insignificant effect of type of birth on weaning weight in Karakul and Hissardale lambs. Differences between the present study and earlier studies on different sheep breeds may be due to a combined effect of genetic and environmental factors (Tariq *et al.*, 2011).

Pre-weaning Average Daily Gain (PRADG): When ANOVA results were considered, statistically significant effects of YOB, TOB and sex on PRADG (P<0.05) in the present study were consistent with the findings of many researchers (Shah and Khan, 2004; Hussain, 2006; Refiq *et al*., 2009; and Mokhtari and Rashidi, 2010). Refiq *et al*. (2009) recorded the data on Turkish Merino (Karacabey Merino) sheep. There were fixed effects due to year of lambing, sex of lamb, type of birth and age of ewe at lambing. Sex of lamb had significant effect on pre-weaning daily gain. The male lambs were 6-16% heavier than female lambs. YOB, TOB and sex were significant (p≤0.01) for PRADG while SOB was an insignificant for PRADG, supporting the present study. Mokhtari and Rashidi (2010) also reported similar findings given in the present study; however, the researchers observed SOB had a significant effect on PRADG, which was in disagreement with the present study. Also, the findings of the present study are not in agreement with the results of the Snowder and Van-Vieck (2003) who accounted that type of birth and sex had insignificant effect on PRADG. The contradictions in findings of the present study and others studies may be due to breed, climatic and ecological differences where sheep farming was practiced.

Table 1. Least Mean values of some Performance Traits in Mengali sheep.

Trait (Weight in Kg)	No. of Obs.	Mean± S.E.
BW	2377	3.54±0.37
1MW	2308	7.96±0.91
2MW	2308	11.77±1.83
3MW	2308	15.51±2.86
WW	2308	19.16±3.23
PRADG (g)	2359	135.00±0.26

Table 2. Non-genetic Factors affecting pre-weaning growth traits

Traits	Location	YOB	SOB	TOB	Sex	Maternal effect	YOB*SOB	TOB*SEX
BW	*	*	*	*	*	NS	NS	NS
MW	*	NS	*	*	*	-	NS	NS
2MW	*	*	NS	*	*	-	NS	NS
3MW	*	*	NS	*	*	-	NS	NS
WW	*	*	NS	*	*	NS	NS	NS
PRADG	*	*	NS	*	*	-	NS	NS

* = Significant (P<0.05), NS= Non Significant (P>0.05).

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Conclusion: Most of the pre-weaning performance traits were influenced by non-genetic factors in Mengali sheep which shows environmental factors can be controlled to achieve higher gains. The twining was poor but lambing rate was quite higher and, secondary sex ratio was according to expectations. Better management and supplementation was important source of differences among flocks at different locations. Flock kept at ESC (Quetta) location performed significantly better in all traits in comparison with other flocks, the differences might be due to regular supplementation of ration to this flock. Male lambs were born heavier than females and single lambs were also significantly heavier than the twins. These findings suggested that Mengali sheep can be improved by selection and better management practices.

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