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Original article

Genetic potentials of Lohi sheep of Multan, Pakistan

M.H. lashari* , Z. Tasawar
Institute of Pure and Applied Biology Bahauddin Zakariya University, Multan, Pakistan.

*Corresponding author; Institute of Pure and Applied Biology Bahauddin Zakariya University, Multan, Pakistan.

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ABSTRACT

The present study was conducted to determine the genetic parameters of Lohi sheep maintained in Multan, Punjab. The mean body weight of adult ewe and ram was 54.26±2.2, 61.75±2.6 kg, respectively. The males were significantly (P<0.05) heavier than females. The adult body weight showed seasonal variations, maximum in May and minimum in January. The mean birth weight in male and female lamb was (3.91±0.12, 3.52±0.1kg), respectively. Three distinct phases of growth were seen in lambs. An initial phase of rapid growth (birth-5 months) in which body weight increased from, 3.91±0.12 to 26.4±0.27 kg @ 125 g/day, followed by moderate growth period (5-9 months) showing weight increase from 26.4±0.27 to 37.3±0.91 kg @ 76.23 g/day, and the third slow growth phase (9-13 months), 37.3±0.91 to 44.70±1.02kg with mean growth rate of 58.14g/day. Fertility rate in ewes was 86.3%. . Twice a year lambing was none and 16.34% lambing resulted in twin birth. Mean litter size was 1.53 per ewe. Lambing occurred in two different season i.e. August to November and February to April. In conclusion the Lohi breed has genetically better reproductive performance, birth weight and growth potentials. The lambs have better survival rate. The Lohi sheep has a good breeding potential and are well adopted to survive under the arid and irrigated condition of the area.

1. Introduction

Pakistan being an agricultural country places a significant dependence on livestock. Livestock are natural factories to convert the grasses into milk and meat. These animals also provide raw material for industries.

The livestock wealth of Punjab is well-adapted to hot and humid conditions, tolerant to tropical diseases and good converters of poor quality roughages into milk and meat. Pakistan has as many as 28 sheep breeds. These are classified into thin tail and fat tail breeds. Lohi sheep are the important thin tail mutton breeds available in southern districts of Punjab province, Pakistan. Sheep and goats contribute significantly to the subsistence, economic and social livelihoods of a large human population under low-input, smallholder production systems in developing countries. Increasing human population and urbanization, coupled with changing consumer preferences is creating more demand for these animals and their products (Kosgey and Okey, 2007).

The small ruminants have lower feed and money requirements than large ruminants making them suited to smallholder producers (Devendra et al., 2002). They also have shorter generation intervals, small size and are better able to utilize a wide range of feedstuff, including crop residues which are of little value otherwise (Holst, 1999). These contributions of sheep ensure the well-being of rural population and development of nation, especially in the arid regions, where crop production is limited thus helping in saving the country from socio-economic problems (Hasnain, 1985). The genetic potential of various breeds of sheep have been reported in various parts of world and Pakistan (Mian and Khan, 1991; Baber et al., 2004; Bahreini Behzadi et al., 2007, Lashari and Tasawar, 2010) but there is little information on the Lohi breed for reproductive traits. The objectives of this study ware to determine the genetic parameters of Lohi sheep in Multan, Punjab, Pakistan.

2. Materials and methods

2.1. Study area

The present study was conducted on Lohi flocks in Multan, Punjab. The flocks in generals are being maintained under natural feeding regime on the general vegetation. The males are usually sold out while the females are maintained for breeding purposes. The young lambs are maintained exclusively on mother's milk, while they are allowed to suckle in the morning and evening when the flocks return to barn after grazing in the field. No supplementary rationing is being exercised for the major part of the flocks.

2.2. Vegetation of the area

Native vegetation predominant in the area is characterized by seasonal crops (Wheat, Cotton and Rice), grasses and perennial trees. The trees commonly found in the area, Jand (Prosopis spicigera) and Frash (Tamarix articulata) the Kikar (Acacia Arabica) also grow in abundant. Shisham (Dilbergia sissoo), Mango (Mangifera indica L.) and Sirin (Albiia lebbek) are also found. Deb (Desmostachya bipinnata) and grass (Cyanodon dactylon) are naturally grown and mainly used as fodder for animals.

2.3. Climate of study area

The climate of this area is exceedingly dry both in summer as well as in winter; the summer season starts in April and continues till October. May, June and July are the hottest months. The mean maximum and minimum temperature for this period are about 40.6 and 27.2°C respectively. The winter season lasts from November to February. December and January are the coldest months. The mean maximum and minimum temperature during these months is about 22.3 and 5.9°C respectively. In March temperature starts rising and from May to August heat is intense whereas in September and October the heat becomes gradually less oppressive. The annual rain fall is the 125 mm in the area.

2.4. Stock selection

A preliminary survey of the area was conducted to select suitable flocks for collection of data. Finally selected flocks were registered and required data record was obtained for each flock on monthly interval basis from various flocks in Multan, Punjab. The data was collected on a prescribed performa every month by direct observation of animals and careful inquiry of flock owners. The flocks selected for the purpose of sampling were basically sedentary in nature, and hence available for recording throughout the year. The stocks were under natural grazing

with no supplement rationing/active feeding from cultivations. The new born lambs were maintained on mother's milk exclusively for the first month of life, while from second month, they grazed as separate flock from adult on natural vegetation, allowing them to suckle the mother in the morning, noon and in the evening till the weaning age.

No organised breeding programme was being followed in these flocks. It was tried to collect information on the origin of each of the sampled individual, both through tracing their history from the farmers as well as through examination of the physical characters, recorded previously in literature.

2.5. Adult body weight

The adult female of local flocks was weighed on monthly basis. Some of the animals initially selected for studies died/sold-out/slaughtered within the period of the study were excluded from the final analysis. The animals were given a field number through a metallic disc in the neck or tattooing on the ear.

Each of the animal was weighed on approximately the same date during different calendar months of the year under study, and record maintained. The general information on pregnancy status of each of the female was maintained, through direct observation and through the information carried by the farmers.

The information on sex, breed, age, twin/ single birth, was recorded for each of the animal separately, however the effects of type of the birth, time of the birth was not considered for the final analysis, as per limitation of the available data. Monthly mean weight was subsequently calculated for different categories of the animal flocks adopting the general statistical techniques, for the purpose of analysis of different factors.

2.6. Growth studies

Different numbers of the newborn lambs of sheep were selected. Each of the individual was given a number and tagged through metallic disk in the neck. The information on the time of the birth was collected from the respective farmer/through indirect information available to the workers and related information about the sex, type of the birth and probable breed were maintained regarding each of the individual separately. Though the information on type of the birth was not regarded to be sufficient for a more elaborate analysis and hence was excluded from the final analysis of the data.

The growth rates were calculated on the assumption that each month is of 30 days duration and was judged by the weight gained by each animal per day. This was calculated by a normal mathematical conversion of dividing the total gain in average weight during the different month of age by 30, though the growth rate was believed to affect through different calendar months and per seasonal variations associated with the vegetation supply in the area.

2.7. Breeding performance

A selected number of females of this stock were exploited to maintain elaborated record on the birth of the young ones. This record was used to conclude the results for once a year/twice a year lambing pattern of each of the female under study. The data was used to determine the proportion of females showing different patterns of lambing.

The record was also maintained on the selected females regarding the number of the offspring's produced by individual female after term. The data thus yielded was used for the calculation of the proportion of the single/twin/triplet births through a direct comparison with the total number of the parturitions examined during study period. Simple mathematical conversions were exploited to reach at the percentage of the different type of the births.

2.8. Statistical analysis

Common statistical techniques were used for the adult body weight and growth rate analysis. The growth rate (increase in weight per day) was calculated. The reproductive efficiency was judged through the proportion ewes lambed within the year. Standard descriptive statistics were used for the calculation of Mean ± SEM using the statistical package of Microsoft Excel. The results are expressed as Mean ± SEM and percentage. Student t-test was used for the comparison of ewes and rams mean body weight, birth weight and growth rate of lambs of different sex. $P < 0.05$ was considered as statistically significant.

3. Results

3.1. Mean adult body weight

The results of the mean adult body weight in Lohi sheep are depicted in Fig. 1. Overall adult body weight of the Lohi rams was 61.75±2.6 kg. Similarly the adult body weight of the ewes of Lohi was 54.26±2.2 kg. It was found that males were significantly heavier than females (P<0.05).

Table 1. presents the adult body weights of during different calendar months. All the sheep of both sexes present a uniform pattern of cyclic variation. The average weight is minimum during January and maximum during the month of May. The mean body weight decreased during July through January, while the increase in body weight was observed from February to onward.

3.2. Birth weight

The results of the birth weight, of the new born lambs are shown in Table 2. The mean birth weight of Lohi ram lambs was 3.91±0.12kg. It was 3.52±0.1kg for ewe lambs of Lohi. It was found that the sex of the new born was a significant factor in birth weight as the males were significantly (P<0.05) heavier than female.

3.3. Growth pattern

The body weights of the lambs of both sexes recorded at different ages is given in Table 3. A general look on the data suggested that the growth rate could be divided into three different phases in sheep. An initial relatively rapid increase in the live weight occurred during the first five months of the age of the new born lambs, increasing the average body weight of Lohi males and females from 3.91±0.12 kg to 7.67±0.13 kg, within one month of birth, to 26.4±0.27 kg respectively, at the age of five months. A moderate degree of increase in the live weight occurred in the lambs during the second growth phase, spreading over month 6-9 of the age. During this phase the body weight increased from 26.4±0.27 to 37.3±0.91 kg in males and 23.71± 0.024 to 34.19±0.83 kg in females. In the third phase extending from the age of 10 to 13 months exhibited a progressively slow increase in the weight of the lamb with a corresponding increased in the age. During this phase, the body weight increased from 37.3±0.91 to 44.70±1.02 in males and 34.19±0.83 to 41.6±1.12 kg in females.

3.4. Turnover rate

The turnover rate (Fig. 2) as judged by the weight gained per day per animal at different ages in different flock size. The turnover rate of Lohi breed was 125 g/day in male lambs and 114 g/day in female lambs. The growth rate thereafter decreased @ 76.23, 63.12 g/day in males and females respectively during month 6 to 9 followed by very slow growth @ 58.14, 46.15 g/day in males and females respectively in higher age groups of 9-13th months. The males exhibited more growth rate than females.

3.5. Breeding performance

A comparative statement of different parameters relating to reproductive efficiency has been presented in Table 4. Female fertility rate in Lohi was 86.3%. Twice a year lambing was zero percent in both breeds. Twining was 16.34% of the live birth in Lohi. Litter size was 1.35/female in Lohi sheep, and no triplet litter was observed. Lambing occurred during August to November and February to April. The postnatal mortality in Lohi was 10.5, %.

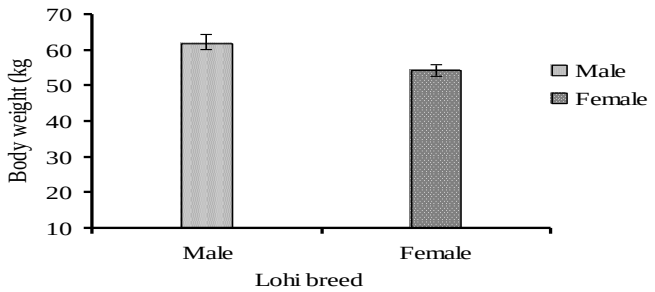

Fig. 1. Mean ±SEM (kg) of adult body weight in male and female Lohi sheep maintained in Multan, Punjab.

Table 1
Variations in adult body weight (kg) of Lohi sheep during different calendar months.

Month	Mean adult body weight (kg)
January	40±2.2
February	44±1.3
March	48±2.3
April	52±3.4
May	56±2.1
June	55±2.3
July	52±3.6
August	53±4.2
September	50±4.2
October	45±1.3
November	43±2.6
December	42±3.1

Table 2
Mean ± SEM (kg) birth weight of lambs maintained in Multan, Punjab.

Lambs	Weight (kg) ± SEM	
	Single	Twin
Male	3.91 ± 0.12	3.50 ± 0.01
Female	3.52 ± 0.1	3.05 ± 0.03

Table 3
Mean ± SEM (kg) growth pattern of Lohi sheep at different ages (months) maintained in Multan, Punjab.

Age (months)	Male	Female
1	7.67 ± 0.13	6.95 ± 0.14
2	12.61 ± 0.15	11.83 ± 0.18
3	17.32 ± 0.21	16.91 ± 0.21
4	22.17 ± 0.24	20.67 ± 0.22
5	26.40 ± 0.27	23.71 ± 0.24
6	29.05 ± 0.59	26.72 ± 0.82
7	31.69 ± 0.61	29.04 ± 0.94
8	34.45 ± 0.72	31.56 ± 0.92
9	37.30 ± 0.91	34.19 ± 0.83
10	38.95 ± 0.99	35.83 ± 0.92
11	40.57 ± 1.12	37.46 ± 0.97
12	42.84 ± 1.06	38.95 ± 0.99
13	44.71 ± 1.02	41.6 ± 1.11

4. Discussion

4.1. Adult body weight

As reported earlier there was significant ($P<0.05$) difference in adult body weight of male and female of both breeds. Breeds have been reported to bear different body weights (Urk, 47 kg, 34; Randozai, 45 kg, 33 and Balali 44 kg; 32) (Mian and Khan, 1991). Mean weights of ewes and rams of Karakuli were 43, 34 kg, respectively (Mian and Khan, 1991). The actual body weight reported by Hasnain (1985) for Kacchi ewe and ram was 32 and 42 kg respectively, which were lower than found in the current study. This may suggest a general as result of the

expected heterosis, may have happened under random breeding. The studies conducted at different times show different results on the same breed like the Afghan sheep flock maintained at Bahadurnagar Research Farm, Afghan males 85.00 kg, females 46.29 kg (Ahmad, 1985), while Ahmad and Ahmad (1987) reported the same Afghan males as 88.82 kg, females 48.74 kg. The adult body weight of the present flock appears greater than Salt range (40-20 kg, Hasnain, 1985). Ahmad and Zafar (1983) have reported that ewes above two years of age are heavier. There is possibility that Hasnain considered < 2 years old as mature individuals whereas animal more than two years of age has been considered for the present study

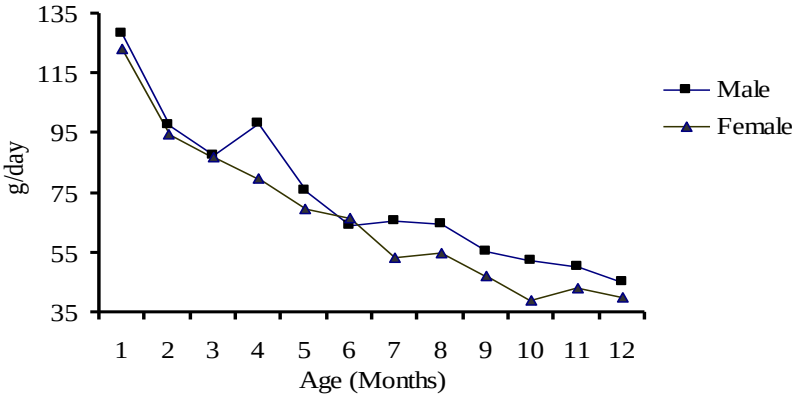

Fig.2. Growth rate (g/day) of male and female lambs at different age.

Table 4
Mean ± SEM summary of the data on different parameters of breeding performance of sheep maintained in Multan, Punjab.

Parameters	Lohi Breed
Fertility (%)	86.3±0.32
Lambing pattern (%)	
Single	85.66
Twining	16.34
Triplet birth	0.00
Lambing pattern (%)	
Once/year	100.0
Twice/year	0.00
Litter size	1.35
Breeding Season (%)	
Summer	48.28
Winter	51.82
Post natal mortality (%)	10.5

The Lohi breed showed higher adult body weight than reported records regarding the other breeds, Kajli in Pakistan 37.4 kg (Qureshi, 1996), Sabi in Zimbabwe 23.5 kg (Matika et al., 2003) and Kermani in Iran 28 kg (Bahreini Behzadi et al., 2007). On the other hand the present study flocks are lighter in adult body weight than Dohne Merino 55.8 kg in South Africa studied by Cloete et al. (2003). The variations in the adult body weight may be due to sheep farming practiced which covers all features of environment, climatic conditions and seasonal variations that vary from year to year (Dag et al., 2003).

The average adult body weights of different flock size during different calendar months. All the flocks and both the sexes present a uniform pattern of cyclic variation. Such a pattern can be associated with the vegetation supply in the area. Similar findings have already been reported by Lashari and Tasawar (2013); Mian and Khan (1991) for the Kachhi flocks in Southern Punjab and sedentary stocks in Balochistan, respectively.

4.2. Birth weight

The sex of the newborn lamb also proved as significant factor in birth weight. The male lamb was significantly ($P<0.05$) heavier than female lamb of both breed. There was no significant difference in single/twin birth weight of lambs.

The mean values for birth weight of present study are higher than those studies of other breeds, 3.09±0.03 kg for Harnai and 3.18 ± 0.02 kg for Bibrik (Haider and Shah, 1974); 2.68±0.75 kg, 3.36±0.03 kg for Muzaffarnagri and Merino lamb in India (Joshi and Datta, 1985), 2.6 kg for Sibi in Zimbabwe (Matika et al., 2003) and 3.32 kg for Kermani lamb in Iran (Bahreini Behzadi et al., 2007). While the mean values of present study are lower than previous investigations 4.2 kg Akkaraman lambs in Turkey (Dag et al., 2003); 4.9± 0.83 kg for Targhee lambs in USA (Hanford et al., 2003) and 3.80±0.04 kg for Ripollesa (Cesellas et al., 2007).

This variation in different studies might be due to the different breeds' genetic makeup and environmental variations (Afzal et al., 2004). Bahreini Behzadi et al. (2007) reported that lambs born to parity four or five ewes were heavier than lambs of younger ewes. They reported the body weight at birth of lamb from 2 years old ewes significantly lower than those of lambs from ewes of older age group.

Type of birth had a significant effect on birth weight. Male lambs were heavier than females and the difference between two sexes increased with the age of lambs. The present results of birth type are in agreement with previous studies of several investigators on other breeds (Baber et al., 2004). Akhtar et al. (2001) also reported that the birth weight of Hissardale male lambs was 3.9±0.02kg and female lambs were 3.5 ± 0.02kg. This may be because of increasing differences in endocrine hormones and their secretions in males and females (Bahreini Behzadi et al., 2007). Matika et al. (2003) and Baber et al. (2004) reported that year of birth, sex, type of birth, rearing status of dams, and dam's age were significant source of variation on birth weight. The lambs born as single were heavier than twins and triplets.

4.3. Growth rate

The results of the present study suggest that lamb weight continuously increased till the age of 13 months. The mean values of the growth rate of lambs belonging to different flock size did not show a ($P > 0.05$) significant difference. The general growth exhibits a triphasic pattern.

Lashari and Tasawar (2010); Mian and Khan (1991) reported the same pattern of growth rate of lambs where an initial period 4 months of age, increase in weight from 6 to 18 kg, followed by month 5 to 9, 18 to 27 kg and the final 10 months to onward 27 to 34 kg. Similarly Qureshi (1996) reported the weaning weight at the age of 120 days and yearling 20.7 kg, 37.4 for Kajli; 20.1kg, 30.7 for Hissardle (Akhtar et al., 2001), 34.6 kg, 45.2 for Turghee in USA (Hanford et al., 2003), 17.2 kg, 33.5 Sabi in Zimbabwe (Matika et al., 2003), 21.31 kg, 32.92 Lohi breed (Shah and Khan, 2004), 21.98 kg, 34.86 Kermani sheep in Iran (Bahreini Behzadi et al., 2007). It shows that the growth rate was lower in present study breed. These variations can also be attributable to the rearing conditions available under different regimes, including the availability of pasture, additional rationing provided and the expertise of the breeders to provide suitable conditions. The effects of better pasture conditions on the general weight of the individuals has been proved by the present study suggesting that under favourable pasture conditions, the individuals gain weight, while it was lost under unfavourable conditions. It was also reported that the weight of sheep increases till the age of two years, so that the mature females are heavier than the females of less than two years in age (Ahmad and Zafar, 1983).

The analysis of the growth rate at different ages, as exhibited by two sexes, suggests that though the males and females lambs are not significantly different in weight at comparative ages as judged by methods of maximum approximation/likelihood; yet the males were heavier than the females at all ages. The female lamb weight of the present study runs below the male at different age groups. The type of sex effects on growth rate is in agreement with Shah and Khan (2004) and Bahreini Behzadi et al. (2007) alongwith number of studies on different breeds of sheep in different areas, suggesting that males are heavier than females at birth, weaning as well as at adult stage (Bahreini Behzadi et al., 2007).

4.4. Turnover rate

The mean values of the turnover rate of lambs belonging to different flock size and breed were not significantly (P>0.05) different. The males exhibited more growth rate than females. Such a variation in the growth rate at different ages can be explained on the general feeding patterns. The lambs being maintained on mother's milk alone for the first month exhibit a restricted growth. An accelerated growth between month 1 and 4 can be attributed to the mixed feeding (mother's milk and natural grazing). After the 4th month, the lambs are generally weaned and are exclusively maintained on natural grazing, when the growth rate drops down.

Present results suggest maximum growth rate falling around 128 to 55.55 g/day/animal. Pre-weaning growth rate of different breeds has been recorded 150g/day (Mian and Khan, 1991), 135g/d Hissardle (Akhtar et al., 2001), 143 g/d Kajli (Qureshi, 1996) 127.8 g/d Muzaffarnagri in India (Mandal et al., 2003), 250 g/day Targhee in USA (Snowder and Vleek, 2003), 126±0.02 g/day Lohi (Shah and Khan, 2004). The low growth rates exhibited by present study flocks can be attributed to genetic differences, yet the fact that the stocks under references are being maintained on additional rationing and better grazing condition may suggest the importance of poor grazing conditions. Devendran et al. (2009) reported low growth rate in Madras Red sheep in India as 1-3 and 9-12 months of age were 73.74 and 23.81 g/d respectively. This contradiction may be due to genetic factors. A very significant effect of different rationing patterns has been suggested by Saleem and Shah (1983).

4.5. Breeding performance

The female fertility rate of Lohi sheep was 86.3%. Twin birth was 16.34 % in Lohi and no triplet litter was observed in this breeds. Different studies available on stocks/breeds maintained in Pakistan suggest a wide variation in the fertility in sheep. Sheep in flocks of present study stands high as compared to others reported for (Karakuli, 75%; Balali 69%; and Randozai 64%) by Mian and Khan (1991), for (Horo, 70.1% and Menz, 79.5%) Berhan and Van Arendonk (2006). But some other studies show higher reproductive rate (97.1% in Afghan) and 90% in general Lebanon nomadic flock (Bhattacharya and Harb, 1978; Ahmad and Ahmad, 1987). This difference could be attributed to genetic and environmental variations. This fact does not necessarily indicate a low reproductive efficiency of present stock and such a difference can be safely attributed to the available nutrition conditions for under discussion. Present stock depended on natural grazing, without organized breeding regime and low nutrition plain, as compared with the stocks run under expert management with care at feeding and general management.

In the present study, all the ewes exhibited once a year lambing pattern and none lambed twice. Present findings are in agreement with Ahmad, (1985), Bhattacharya and Harb, (1973), Mian and Khan, (1991) Lashari and Tasawar (2010) for Lohi, Afghan, Lebanon nomadic flock, Randozai and Kachhi flocks respectively.

The frequency of twin birth was 13.60%, and the rate of triplet birth during the study period was none. The present study flock exhibits low twin birth on comparing with the breeds like Randozai (14%), Urk (15%) and Balali (31%), while the frequency of twin birth is higher than Karakuli 0% (Mian and Khan, 1991). This may be due to the genetic variations. Similarly the reported twin birth in Lohi: 28% (Hasnain, 1985), 9.3%, 1.6% Triple births (Ahmad and Khan, 1985), Afghan: 8.53 (Ahmad, 1985) collected on the stocks maintained under organised farming conditions at Bahadurnagar Farm, suggests the importance of present stocks, which were being maintained under stressful natural grazing.

The number of lambs born per ewe per year appeared to be a comprehensive parameter regarding the overall reproductive efficiency of the stock. The computed value regarding present stock suggested that the average number of the lamb produced /ewe /year was 1.5 lambs. Similar manipulation of the data reported different figures in literature, (Balali: 1.31, Urk 1.05, Randozai: 1.04 and Karakuli: 0.83 (Mian and Khan, 1991), Afghan: 1.07 (Ahmad and Ahmad, 1987) and 1.7 (Casellas et al., 2007) maintained under controlled farming conditions. This may suggest that the local stocks maintained good breeding potential.

Wide variations in the number of the lambs produced per ewe per year might be due to environmental factors, apart from the genetic ones, which collectively contribute in the overall potentials of a breeding stock to produce the number of lambs. Under better breeding conditions supported by supplemented rationing, it has been shown that the litter size will increase from 1.06 lambs produced per ewe per year to 1.89 in Kachhi sheep (Lashari and Tasawar, 2010).

Different stocks appeared to have different potentials of breeding during summer and winter. In the present study stock 50% parturition occurred in May-June and other 50% lambing during November-February. Current

study stock appears to have two reproductive seasons, and a good proportion of the flock lambing during summers and also in winters.

The reproductive activity occurs in November and December, some extending up to early January. This information confirms the concrete finding that sheep are short day animals. This pattern also appears to fit in the general vegetative cycle being followed in the area, so that newborn are produced during the periods, when the vegetation are sufficiently available. Study performed by Bhattacharya and Harb (1973) suggests monthly variation in the reproductive activity in sheep to support the present findings.

The available data suggested that the flocks maintained in the study area remain reproductively active between the age of 2 and 7 years. Limited fertility has been exhibited in the ewes of more than 7 years of age, and those of less than 2 years of age; however, ewes of different ages exhibit variable fertility as studied by Mian and Khan (1991) and Lashari and Tasawar (2010).

4.6. Survival of the lambs

The present study suggests that 88.1 % of the Lohi lamb enters weaning stage. The survival rate in lambs at pre-weaning stage appears to be lower than the stocks maintained in Balochistan 93.75 % (Mian and Khan 1991), 94.38 % Ripollesa ewes in Spain (Casellas, 2007). The survival rate is to be higher than that suggested for Lohi breed 56.54 % (Ahmed and khan, 1985), Afghan breed 81.01 % (Ahmed and Ahmed) and in Lebanon nomadic stock 91 % (Bhattacharya and Harb, 1973). This may suggest good genetic potentials of present stocks to survive under the available condition.

5. Conclusion

The Lohi breed has better reproductive performance, birth weight and growth potentials. The lambs have low mortality rate. Moreover these flocks have a good breeding potential and are well-adapted to survive under arid and semi-arid conditions of the region.

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