Productive and Reproductive Performance of Kajli and Lohi Ewes

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ABSTRACT : Data from 22837 lambings of Lohi and Kajli ewes from 1962 through 1994 were used to analyse productive and reproductive traits and wool production. Overall litter size at birth averaged 1.33 being 1.45 for Lohi and 1.21 for Kajli ewes. The corresponding values at weaning were 1.23, 1.32 and 1.14, respectively. Litter size was consistently lowest for one year old, with a substantial increase at two, three and four years of ewe age and marginal increase thereafter, Ewes lambing in spring weaned 0.08 more lambs per parturition than ewes lambed in Autumn ($p < 0.01$). Lamb birth weights were affected by ewe breed ($p < 0.01$) and increased with ewe age. Overall lamb weaning weight (120 d) of 17993 lambs was 20.3 kg. Weaning weight was affected by breed, sire, year of birth, sex, rearing rank and weaning age ($p < 0.01$). The highest mean weaning weight was 21.9 kg for Lohi lambs followed by Kajli lambs (18.8 kg). Lambs from Kajli ewes were 9% heavier at birth but 14% lighter at weaning. Twin born lambs were 18% lighter at birth and 13% at weaning than single born lambs. Male lambs were 3% heavier at birth and 4.5% heavier at weaning than female lambs. Overall annual mean wool production was 2.64 kg. Kajli ewes were heavier at breeding than Lohi ewes (i.e. 46.2 vs 44.8 kg). Lohi ewes being 3% less body weight produced 38% more wool and 18% more litter weaning weight than Kajli ewes. When average weight of lamb weaned per ewe weaning lambs was adjusted for ewe average metabolic body size, Lohi ewes were most efficient (i.e. arbitrary assigned value of 100) compared to Kajli ewes achieving only 83% of Lohi level.

(**Key Words:** Ewes, Breed, Reproduction, Litter Size, Weaning, Lohi, Kajli)

INTRODUCTION

Pakistan is rich in small ruminant resources. It has about 30 million sheep with 28 recognized sheep breeds and stands tenth in ranking of the world sheep population. Meat is a major product of sheep (> 300,000 tonnes/ year) and it accounts for 18% of the total meat produced in the country (Livestock Division, 1993). Lohi sheep are found in a wider areas of Punjab province and is known to be one of the best dual purpose breed of the Punjab for meat and wool production. Contrarily, Kajli sheep are found in a narrow belt of Sargodha division and have not been raised extensively outside this area in the country. This breed is also very popular especially for sacrificial purposes on *Eid-Al-Azha*. Both breeds are of large body size belonging to irrigated areas of Punjab but lack scientific comparison for their economic traits of importance based on their long term performance. A few studies were reported for individual breeds but comparison of these two important sheep breeds of Punjab has not been made earlier. Hence, the present study was designed to compare lamb production merits of Kajli and Lohi sheep breeds from its long term performance data from two different locations from 1962 through 1994. Components of production such as fertility, litter size at birth and weaning and growth traits were compared for both breeds. Ewes were compared for their output relative to their body weight at breeding. The production trends over 32 years and effects of environmental factors on the performance traits were studied.

MATERIALS AND METHODS

Source of data and animal management

Data for Kajli sheep were collected from Livestock Experiment Station, Khushab and Khizerabad. The stations are 150 km north of Livestock Production Research Institute, Bahadurnagar, situated in Punjab

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Received December 11, 1997; Accepted July 27, 1998

province from where Lohi data were obtained. Reproduction, wool and lamb production records of Kajli ewes from 1977 through 1994 and Lohi ewes from 1962 through 1993 were used in the study. Distribution of ewes by year and breed has been shown in figure 1. Due to similarity in weather conditions the management practices for both breeds were more or less similar. Generally, the animals were maintained in open sheds with adequate covered space to be used as shade and shelter for harsh summer and winter. Breeding rams, dry and lactating ewes and lambs were kept in separate sheds. Ewes were grazed in fodder and forages grown on the farm land, and usually supplemented when necessary with concentrate before and during breeding (August - October), lambing and feed scarcity period.

Ewes were bred during autumn for spring lambing. Those ewes that failed to breed in autumn were bred during spring for autumn births. Therefore, the data contained a large proportion of spring born lambs and relatively small number of autumn born lambs. The rams used for breeding were mostly from the farm flock. However, some rams were purchased to provide a broader genetic base. Teasers with colour bags were used to detect ewes in heat. The ewes were inseminated with fresh diluted semen of selected rams using A.I. in case of Lohi sheep only, whereas natural mating was practiced in Kajli sheep.

Ewes were moved into sheds about 2 weeks before lambing in January and they were penned in groups of 20-30. Ewes were under constant surveillance at lambing. Immediately after lambing, lambs were weighed and ewes and their offspring were placed in separate pens for easy management. The lambs were allowed to suckle their mothers at night. Most ewes returned to pasture/fodder grazing with their lambs within 15 day lambing, depending on weather conditions. Lambs remained with their mothers on grazing pasture from morning to late afternoon and in sheds during nights until weaning at 120 days. Preweaning nutritional supplementation was supplied to ewes and lambs. Ewes were routinely treated against infectious diseases such as enterotoxemia and pleuropneumonia as prophylactic measures. For controlling external and internal parasites, de-wormers such as Nilzan (ICI) and Neguvan/Ausentol (Bayer), were used throughout the period of data collection.

Ewes were culled for old age, failure to produce milk or udder infection and for poor body conditions. Usually replacements were selected from lambs born in the flock.

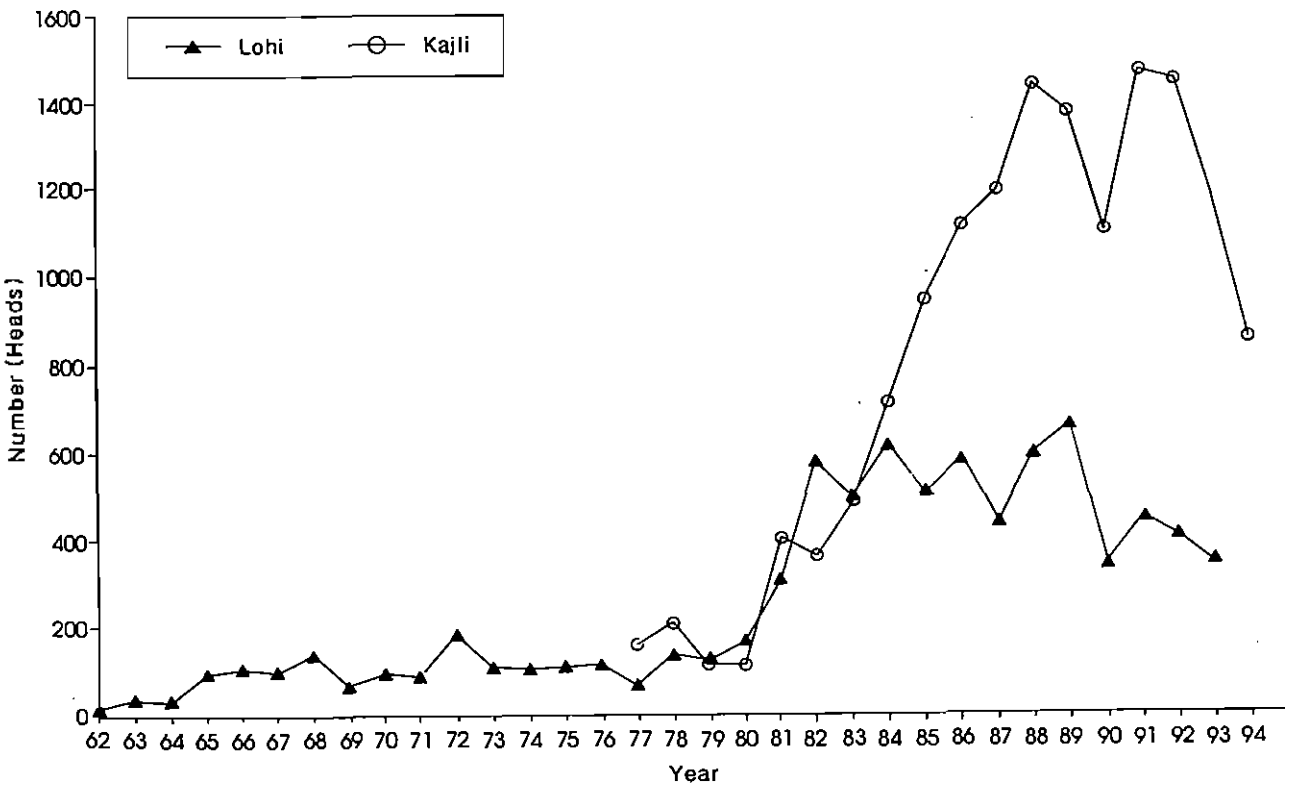

Figure 1. Distribution of Kajli and Lohi ewes (1962-94).

Ewes were shorn from February to April during spring and September to November during autumn. Individual fleece weights were recorded from 1981 through 1993.

Statistical procedure

Performance traits analysed were as follows: LS, litter size at birth (including dead or aborted lambs) for each ewe lambing (1, 2, 3); LSW, number of lambs weaned for each ewe lambing (0, 1, 2); EBWT, ewe weight at breeding; BWT, lamb weight at birth and at WWT, weaning and PADG, preweaning average daily gain. LS at birth, LSW, EBWT and wool production were regarded as ewe traits, whereas BWT, WWT and PADG were analysed for individual lambs.

BWT, WWT and PADG were analysed with models containing breed, birth year, dam age, season, sex and birth rearing rank as fixed affects in the model. Sire was also included in the model as random effect. For weaning weight analysis weaning age was used as covariate. A statistical model used to describe all lamb traits was as follows: $Y_{ijklmn} = \mu + B_i + Y_j + BS_k + S_l + D_m + R_n + E_{ijklm}$, where μ = overall mean, B_i = the effect of $_i$th breed (i = 1, 2), Y_j = the effect of $_j$th lamb birth year (j = 62 – 93), BS_k = the effect of $_k$th lamb birth season (k = 1, 2), S_l = the effect of $_l$th lamb sex (l = 1, 2), D_m = the effect of $_m$th dam age (m = 1 – 8), R_n = the effect of $_n$th lamb rearing rank (n = 1 – 3) and E_{ijklmn} = random variation. GLM procedure of SAS (1986) and Harvey (1987) were used to analyse ewe and lamb traits. Ewe traits were analysed using similar model. Multiple comparisons were made among means using the Student-Newman-Kuels procedure (Sokal and Rohlf, 1969).

Relative efficiencies were calculated for each genotype by dividing annual weight of lamb weaned per ewe mated by the genotype's mean metabolic size ($EBWT^{.75}$; Kleiber, 1975) at mating. Metabolic body size was used because it was the best available indicator of ewe nutritional requirements as they apply to lamb production under grazing conditions. The most efficient genotype was arbitrarily assigned a value fo 100 and the efficiency of the other breed was expressed relative to 100.

RESULTS

Litter size at birth and weaning

Means for litter sizes are shown in table 1. Lohi ewes produced 0.24 more lambs per lambing than the Kajli ewes ($p < 0.01$). The overall mean litter size at weaning averaged 1.23. Superiority of Lohi ewes for litter size at birth sustained later at weaning being 0.18 more lambs per lambing. Litter size varied among years, ewe age and season of lambing ($p < 0.01$). Litter size at birth was

Table 1. Least square means and standard errors for litter sizes at birth and weaning and ewe breeding weight (kg) of two sheep breeds

Item	No.	Litter size at birth	Litter size at weaning	Breeding weight
Breed		**	**	**
Kajli	14,637	1.21 ± .01	1.14 ± .01	46.2 ± .13
Lohi	8,200	1.45 ± .01	1.32 ± .01	44.8 ± .19
Ewe age		**	**	**
1	479	1.27 ± .04^{c}	1.10 ± .02^{c}	35.0 ± .46^{c}
2	5,836	1.26 ± .01^{c}	1.15 ± .01^{c}	40.2 ± .17^{bc}
3	5,082	1.33 ± .01^{bc}	1.21 ± .01^{bc}	44.9 ± .17^{ab}
4	4,348	1.37 ± .02^{b}	1.27 ± .01^{a}	47.3 ± .20^{a}
5	3,071	1.35 ± .02^{b}	1.28 ± .01^{a}	49.0 ± .24^{a}
6	2,095	1.40 ± .02^{ab}	1.29 ± .01^{a}	49.9 ± .29^{a}
7	1,347	1.28 ± .03^{c}	1.29 ± .01^{a}	48.9 ± .40^{a}
8	579	1.48 ± .04^{a}	1.24 ± .02^{ab}	48.6 ± .50^{a}
Season		**	**	**
Spring lambing	15,534	1.36 ± .01	1.27 ± .01	45.2 ± .14
Autumn lambing	7,303	1.30 ± .01	1.19 ± .01	45.7 ± .17
Overall	22,837	1.33 ± .01	1.23 ± .01	45.5 ± .13

** $p < 0.01$.

^{a,b,c} Means in the same column within categories without common letter in their superscripts differ ($p < 0.05$).

consistently lowest for one and two year old, with a substantial increase at three and four years of ewe age and marginal increase thereafter. Ewes lambing in spring produced 0.06 more lambs per parturition than ewes lambed in autumn ($p < 0.01$). The difference increased as ewes lambing in spring weaned 0.08 more lambs per parturition than ewes lambed in autumn ($p < 0.01$).

Birth weight, weaning weight and preweaning daily gain

These results are shown in table 2. Overall lamb birth weight averaged 3.23 kg and was affected by breed, birth rank, sex and dam gae. Birth weight of Kajli lambs were 9% heavier than Lohi lambs ($p < 0.01$). Lamb birth weight increased with the dam age or parity. Birth weight of lambs incresed consistently until ewes attained 6 year of age and leveled off thereafter. The mean birth weight of twin born lambs was 3.22 kg, being 18% lighter than single born lambs and 13% heavier than triplets. Birth weight of spring born lambs was 2.4% higher than autumn born lambs ($p < 0.01$). Males were 3.4% heavier than females at birth ($p < 0.01$).

Table 2. Least square means and standard errors for birth weight, weaning weight and preweaning average daily gain (ADG) for Kajli and Lohi lambs

Item	No.	Birth weight (kg)	Weaning weight (kg)	Preweaning ADG (g)
Breed		**	**	**
Kajli	11,488	3.47 ± .16	18.8 ± .82	127 ± 7
Lohi	6,505	3.18 ± .18	21.9 ± .92	154 ± 8
Birth/rearing rank		**	**	**
Single	12,024	3.91 ± .16^{a}	23.2 ± .80^{a}	163 ± 7^{a}
Twin	5,922	3.22 ± .16^{b}	20.1 ± .81^{b}	141 ± 7^{b}
Triplet	47	2.85 ± .19^{c}	17.7 ± .99^{a}	119 ± 9^{c}
Season		**	**	**
Spring	12,707	3.37 ± .16	21.8 ± .84	153 ± 7
Autumn	5,286	3.29 ± .16	18.8 ± .84	129 ± 7
Sex		**	**	**
Female	10,652	3.27 ± .16	19.9 ± .84	139 ± 7
Male	7,341	3.38 ± .16	20.8 ± .84	143 ± 7
Dame age		**	**	**
1	219	3.09 ± .17^{c}	19.0 ± .89^{b}	133 ± 7^{b}
2	4,355	3.16 ± .16^{c}	19.7 ± .83^{b}	135 ± 7^{b}
3	3,990	3.33 ± .16^{bc}	20.5 ± .84^{ab}	142 ± 7^{a}
4	3,591	3.37 ± .16^{bc}	20.8 ± .84^{ab}	145 ± 7^{a}
5	2,589	3.43 ± .16^{b}	21.2 ± .84^{a}	147 ± 7^{a}
6	1,735	3.44 ± .16^{b}	20.8 ± .84^{ab}	144 ± 7^{a}
7	1,048	3.40 ± .16^{b}	20.6 ± .85^{ab}	144 ± 7^{a}
8	466	3.88 ± .17^{a}	20.0 ± .86^{ab}	137 ± 7^{ab}
Overall	17,993	3.23 ± .16	20.3 ± .84	141 ± 7

** $p < 0.01$.
^{a,b,c} Means in the same column within categories without common letter in their superscripts differ ($p < 0.05$).

Weaning weight

Overall lamb weaning weight (120 d) averaged 20.3 kg, and was affected by breed, sire within breed, year and season of birth, sex, rearing rank, damage and weaning age ($p < 0.01$). The higest mean weaning weight was 21.9 kg, for lambs from Lohi ewes being 16% heavier at weaning than lambs from Kajli ewes. Twin born lambs were 13% lighter than single born lambs and 14% heavier than triplets at weaning. Male lambs were 5% heavier at weaning than female lambs. Mean weaning weight of lambs increased as dam age increased from 2-5 year of age and leveled off afterwards (table 2).

Preweaning daily gain

Overall preweaning daily gain averaged 141 g (table 2) and differed between breeds ($p < 0.01$). Lohi lambs grew 27% faster than Kajli lambs. Preweaning daily gain differed among birth/rearing classes ($p < 0.01$). Single lambs grew the fastest (163 g) followed by twins (141 g) and triplets (119 g). Spring born lambs grew 19% faster ($p < 0.01$) than autumn born lambs, whereas males grew 3% faster than females ($p < 0.01$).

Wool production

Fleece weight means of spring and autumn shearing along with total annual fleece are shown in table 3. Overall means for spring and autumn clips were 1.35 kg and 1.29 kg, respectively. Lohi ewes produced 33% and 43% more wool in spring and autumn respectively, than Kajli ewes. Overall mean annual wool production was 2.64 kg; being 2.22 for Kajli ewes to 3.06 for Lohi ewes ($p < 0.01$). Lohi ewes produced 38% more wool per annum than Kajli ewes. In spring clip, ewes produced 5% more wool than autumn clip. Ewe age had significant effect on wool production ($p < 0.01$). Wool production was consistently lowest for one year old with substantial increase at two year of age and marginal increase thereafter until six year of age.

Table 3. Least square means and standard errors of wool production for Kajli and Lohi ewes

Item	No.	Spring	Autumn	Annual
Breed		**	**	**
Kajli	3,376	1.15 ± .01	1.06 ± .01	2.22 ± .01
Lohi	2,116	1.54 ± .01	1.52 ± .01	3.06 ± .02
Ewe age		**	**	**
1	756	1.18 ± .01^{b}	1.16 ± .01^{b}	2.34 ± .02^{c}
2	1,312	1.28 ± .01^{b}	1.27 ± .01^{ab}	2.55 ± .02^{bc}
3	1,102	1.33 ± .01^{ab}	1.28 ± .01^{ab}	2.60 ± .02^{bc}
4	849	1.38 ± .01^{ab}	1.27 ± .01^{ab}	2.64 ± .02^{bc}
5	639	1.36 ± .01^{ab}	1.29 ± .01^{ab}	2.65 ± .02^{bc}
6	412	1.41 ± .02^{a}	1.35 ± .02^{a}	2.76 ± .03^{ab}
7	290	1.39 ± .02^{ab}	1.35 ± .02^{a}	2.74 ± .03^{ab}
8	132	1.44 ± .03^{a}	1.38 ± .03^{a}	2.81 ± 0.5^{a}
Overall	5,492	1.35 ± .01	1.29 ± .01	2.64 ± .01

** $p < 0.01$.

^{a,b,c} Means in the same column within categories without common letter in their superscripts differ ($p < 0.05$).

Litter weight weaned

Overall litter weaning weight of ewes weaning lambs was 33.5 kg and was affected by breed and season. Mean annual weight of lamb weaned per ewe weaning lamb by Kajli ewes was less than Lohi ewes i.e. 30.7 vs 36.3 kg, resepctively ($p < 0.01$). Spring lambing ewes weaned more lamb weight than autumn lambing ewes being 35.3 vs 31.7 kg, respectively. Ewes weaning single and twin lamb were also compared to quantify the advantage of weaning an extra lamb by an ewe. Mean for the ewes weaning twin lambs was 43.3 being 83% higher than ewes weaning singles (23.7 kg).

Lamb production ralative to ewe weight

Mean ewe body weight at breeding was 45.5 kg (table 1). Kajli ewe were heavier than Lohi ewes (46.2 vs 44.8; $p < 0.01$). The ewe body weight was effected by their age and season ($p < 0.01$). Lohi ewes being 3% less body weight produced 18% more litter weaning weight than Kajli ewes. When average weight of lamb weaned was adjusted for ewe average metabolic body size (annual litter weaning weight of lamb weaned per ewe mated/ ewe breeding weight)[25], Lohi ewes were the most efficient per ewe weaning lambs, producing 2.096 kg of lamb weaned per unit of ewe metabolic body size followed by Kajlis (1.732). Result for Kajli is shown relative to Lohi ewes (arbitrary assigned a value of 100). The Kajli ewes were less productive, achieving only 83% of Lohi level.

DISCUSSION

Ewe productivity is made up of many components such as reproductive growth and wool traits and thus can

be defined in numerous ways. The decision to measure on an annual basis (e.g., weight weaned/ewe weaning lambs) depends on the replacement cost. Since the replacement cost has become important due to very high price of sheep meat in this country, the breeds were compared for component traits along with annual output. The advantage of high litter size at birth could not be fully realized due to higher preweaning lamb mortality among the Lohi ewes. This is contrary to the finding of Lewis and Burfening (1988); however, in line with the results reported by Rohloff et al. (1982) that lamb mortality increases with the increase of mean litter size. The superiority in litter size in spring lambing seems to be due to planned breeding and preferential treatment such as flushig etc. Whereas ewes failed to lamb during spring mostly lambed in autumn. Moreover, some ewes lambed twice a year, first in spring and then in autumn. Ewes in autumn, due to non-preferential treatment and/or twice a year lambing, did not seem to have enough body reserves to produce litter size comparable to that of in spring season.

The pattern of birth weight of lambs has shown high relative values for Kajli lambs probably due to relatively larger body size of Kajli ewes than pure Lohi ewes. The highest survival was observed for single born lambs, whereas the highest mortality was for triplets and twins. Purser and Young (1964) suggested that birth weight of lambs, rather than litter size, has the major effect of preweaning lamb survival bacause lambs of equal birth weigth had equal survival regardless of type of birth. Single born lambs have higher birth weight than twins and triplets, and hence had better chance for survival. Twins and triplets on the other hand, had lighter average birth weight and more subject to physiological starvation. This phenomenon was observed by Fahmy and Dufour (1988) who reported that mortality increased progressively from 10 to 17% for lambs from 1/8 Finn to 7/8 Finn ewes.

The superiority of Lohi lambs over purebred Kajli lambs at weaning suggest low milk production of Kajli ewes following birth of lambs. This trend was observed by earlier study of Nawaz and Meyer (1992) who reported that lambs from Polypay sired ewes were lighter than Coopworth sired ewes at birth (i.e. 4.53 vs 4.72 kg) but heavier at weaning (i.e. 27.2 vs 26.2 kg). The superior litter size of Lohi ewes combined with the highest lamb weaning weight resulted in production of the greatest litter weight weaned per ewe weaning lambs. Based on average litter weight weaned per ewe weaning lambs, Lohi ewes were 18% superior to Kajli ewes, a reflection of breed's high growth characteristics and milk production (Snowder and Glimp, 1991).

The importance of reproductive rate in determining weight of lamb weaned is illustrated by the 83% greater average litter weight of ewes weaning twins over that of weaning singles. The superiority for weight of lamb weaned by twining ewes over those raising single lambs is much higher than that was observed by Black (1982) and Nawaz et al. (1992) i.e. 32% and 54%, respectively. Survival to weaning has major effects on number of lambs weaned per ewe, and its genetic correlation with weight weaned per ewe is high (Fogarty et al., 1984).

The considerable variation observed in reproductive traits and birth and weaning weight over years seem to be primarily due to years, ewe age and season, a long lasting environmental effects. Ewes produced lambs of increasingly heavier birth and weaning weights with successive parities. Body weight and reproductive performance were lowest at the age of one year, as expected for young ewes (Dickerson et al., 1975). The effect of ewe age on birth weights tended to be curvilinear, as previously reported by Hight and Jury (1970), Dickerson et al. (1975) and Lewis and Burfening (1988).

Relative performance of Lohi and Kajli sheep breeds to that of Awassi, Rambouillet and Suffolk sheep breeds was compared for litter size and lamb growth. Mean litter size was 1.13, 1.56 and 1.56 for Awassi, Rambouillet and Suffolk ewes (Fogarty et al., 1984; Epstein, 1985). Rambouillet ewes had shown higher mean litter size in their temperate environment than that of Lohi and Kajli ewes. However, litter size and growth performance of imported Rambouillets was compareable to the native breeds (Nawaz et al., 1992). Lamb weaning weights of Kajli and Lohi breeds were substantially lower than the recorded weaning weights of Awassi and Suffolk lambs (i.e. 20, 27 and 35, respectively).

Comparison of productivity (i.e output) should also be taken into account the biological input differences that may exist between breeds. This study assessed annual out put and adjusted output relative to metabolic body weight because it was not possible to measure nutritional intake by two breed mainly under year around grazing. Kajli ewes suffered both smallest litter size and lightest lamb weaning weight. As a consequence they produced the least weight of lamb weaned per ewe weaning lambs. Estimation of relative efficiency by dividing production per ewe mated by metabolic body size resulted in the Lohi ewes surpassing the Kajli ewes, which were 1.5 kg heavier. Combining lamb and wool production to assess gross out put in a study of Nawaz et al. (1992) resulted in very little performance difference inspite of high

difference in ewe body weight.

The 38% greater wool production of Lohi ewes over Kajli ewes supports the prevailing concept that Lohi is known to be the best carpet wool producing breed in the Punjab Province. Moreover, average wool production of Lohi is higher than any local sheep breed as it has excelled Awassi and Kachhi ewes for wool production at the same station (Nawaz et al., 1985) but comparable to wool prduction of Awassi breed in Middle East (Epstein, 1985). However, annual greasy wool production of Lohi and Kajli breeds was much lower than Rambouillet sheep i.e. 2.6 vs 3.4 kg (Magid et al., 1981). Which is a fine wool producing breed. Improved productivity and marketing preference accentuates the development emphasis placed on the breed for meat and wool production of Lohi ewes seem to result in establishing superior genetic effect among the native sheep breeds.

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