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Production Performance of Jamuna Basin Lamb under Semi-Intensive Management System in Bangladesh

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Abstract: The study was aimed to understand the production performances of Jamuna basin lambs at different ages from some selected areas of Sherpur district. For this purpose, growth performance data on 360 lambs were collected from October 2018 to September 2019. Statistical analyses were done using SPSS-v-20 version computer software. The means of body weight of Jamuna basin lambs were 1.46±0.01, 3.58±0.05, 6.65±0.10, 9.84±0.25, 14.74±0.74 and 17.00±0.63 kg, respectively at birth, one, three, six, nine and twelve months of age. Sex had significant effect ($p<0.05$) at six month of age. Body weight and average daily gains were higher in male than female lambs at different ages. Litter size had highly significant effect ($p<0.001$) on birth weight and weight at one month of age. Single born lamb had higher birth weight and average daily gain than twins and triplets. A significant ($p<0.05$) effect was found on the weight at three months of age due to seasonal influence. Average Daily Gain (ADG) from one, three, six, nine and twelve month was found 119.33±2.25 & 119.00±2.20, 73.89±2.17 & 71.67±2.45, 54.67±4.03 & 54.83±4.67, 54.59±2.30 & 52.59±3.60 and 51.34±3.59 & 46.27±4.11 g/day, respectively in location wise. Mortality was relatively higher within 3 month of age. The improvement in litter size, body weight and survival represent potentially significant economic advantage of Jamuna basin lamb. In conclusion, sex, litter size, body weight, season, location and flock size used in the study are important source of variation for growth traits in Jamuna basin lamb.

INTRODUCTION

Jamuna basin sheep is characterized by small body size (male: 18-25 kg, female: 15-22 kg) widely distributed at Tangail, Sirajgonj, Gaibandha, Sherpur, Jamalpur, Mymensingh and Dhaka specially, both sides of Jamuna river in Bangladesh. Coat color of Jamuna basin sheep is grey along with black or white patches. The face, feet and ears are mostly light black color. Wool of Jamuna basin lamb is coarse and modulated. Less wool found in legs

and belly. It is a prolific variety of Bangladeshi sheep, female produce twin lamb in most of the cases. Jamuna basin sheep successfully survives with local grass, tree leaves along with some concentrate feeds. It provides a significant amount of mutton/lamb in local meat market of Bangladesh as well as improves the rural poor livelihood. Sheep farming requires less capital than other agricultural production. This sector is characterized by a lack of technical services and training and a lot of varied the productivity[1, 2]. The growth of livestock production is one of the most important sub-sectors of agriculture in Bangladesh[3]. Per capita meat consumption is 124.99 g/d whereas per capita meat requirement is 120 g/d indicates a surplus meat production in Bangladesh[4]. Sheep is one of the most important partners of this meat revolution in Bangladesh. Sustainable meat production is one of the main objectives of Department of Livestock Services (DLS) to enhance animal protein security for building meritorious nation. A total of 32% sheep are reared in three ecological zones like Barind tract, Jamuna basin and Coastal areas from 3.537 million sheep in Bangladesh[4]. Native regional sheep have the potentiality to profitable lamb production contributing in meat requirement, livelihood improvement and income generating activities. Lacks of public awareness, misconception about lamb/mutton and inadequate nutrition supplementation are the main limiting factors for sheep farming in Bangladesh. Sheep are raised on harvested or fallow lands, roads and canal sides and also grazed on aquatic weeds without any supplementation under traditional feeding system[5]. No other domestic animals can sustain on such type of feed. Their live weight ranges from 15-25 kg and are well adapted to hot humid climate[6]. Sheep are resistant to disease in the tropical and sub-tropical regions. Native sheep were neglected in the past and therefore, there is limited information about the potentials of native sheep. Henson[7] stated that improvement of local breeds can be an integral part of conservation programs. Economic importance of sheep rearing is increasing body weight and growth rate that demand special attention in order to improve/increase lamb/mutton production. Improving the growth performance is the one way which is to select the best animals and the productivity of sheep is essential for higher growth rate for optimal mutton yield[8]. Average birth and yearling weights reported in Kajli breed was 4.0 and 36.5 kg[9]. The lambs born in triplet or twins showed high mortality than the single born. The highest mortality rate (12.2%) was during spring season following (5.5%) in summer season. The overall mortality rate (43.7%) due to pneumonia was recorded followed by gastro-enteritis (19.2%) and heat stroke (10.7%). The ewe of 3 year age showed the highest overall lamb mortality rate (44.1%) than 4 year old dam (25.7 %) as a result rate was reduced as the dam become older[10]. Now, it is an important issue to improve native sheep for better production of quality mutton and wool. The profitability should be increased by production of mutton and especially lambs are produced at a marketable age. The technical assistance can be provided to the sheep producers by organizing the rural sheep keepers through community based sheep production system. Only a little work has been carried out to know growth of indigenous lamb in Bangladesh. Hence, the study was undertaken to determine growth performance and the effects of different factors on body weights at different ages of Jamuna basin lamb of Bangladesh under rural management conditions.

MATERIALS AND METHODS

Study area: The study was conducted in Sherpur Sadar and Nalitabari Upazila of Sherpur district. Sherpur district is bounded on the north by India, on the east by Mymensingh district, on the south and west by Jamalpur district and located about 198 km (123 mi) North of Dhaka which is the capital of the country. Jamuna river flows by the West side of this district and Jamuna basin sheep is available in this area. It lies between 24º18’ and 25º18’ North latitudes and between 89º53’ and 90º91’ East longitudes. The annual average temperature of this district varies from maximum 33.3°C to minimum 12°C and rainfall is 2174 mm.

Source and management of data: On-farm data were collected by trained enumerators from October 2018 to September 2019 for this study. The enumerators were supervised by Principal investigator on a monthly interval basis. Animals were identified by permanent plastic ear tags. Records on birth date, birth weight and postpartum ewe body weight and litter size, sex of lamb, arity of dam were taken into consideration. Live weight of lambs and adult sheep were taken monthly basis using digital scale (50 kg capacity).

Animals and management

Flock size: The farmer who received 5 sheep, 10 sheep and15 sheep constitutes a flock of 5, 10 and 15 group having one ram in each group. Sixty households (30 from Sherpur Sadar and 30 from Nalitabari) were participated in the study constructing equal group of flock.

Flock management: All the farmers reared sheep in semi-intensive system. Farmers were provided their sheep keeping house made of Anwar cement sheet with a wooden slatted floor raised above three feet from the ground level. All sheep were kept inside the house at night and grazed 6-7 h by day. Leaves of tree viz., mango leaves, jack fruit leaves, banana leaves or cutting grass from cultivated land was fed during the rainy season. Farmers someone used to concentrate (crushed maize,

soybean meal, DCP, vitamin-mineral premix and iodine salt containing 18% CP and 12 MJME kg^{-1} DM) in morning and again in afternoon at the rate of 150 g/sheep per day. Pure drinking water was supplied ad libitum for sheep. Farmers supplied little bit more grass and tree leaves to their lactating ewes than that of pregnant ewes while they supplied more amount of concentrates feed to their pregnant ewes than that of lactating ewes. The sheep flocks were de-wormed against internal and external parasites three times a year. They were vaccinated against PPR.

Parameters studied: In order to growth performance of Jamuna basin lamb the used parameters were birth weight, body weight, effect of sex, litter size, season, location, flock size, Average Daily Gain (ADG), mortality and diseases.

Statistical analysis: Data was edited using Excel 2013. Data were tabulated and analysed with descriptive statistical method to fulfil the objectives of the research. Descriptive statistical tools such as frequency, average and percentages, standard deviation, correlation coefficient, etc. were identified. Tabular technique was applied for analysis through SPSS-v-20 version computer software.

Statistical model for growth traits:

$$Yijklm = \mu + Si + Mj + Rk + Tl + Fm + Eijklm$$

Where:

Yijklm = The dependent variable (individual animal record for the trait)
μ = Overall mean
Si = Fixed effect of lamb sex (i = Male, Female)
Mj = Fixed effect of litter size (j = Single, Twin, Triplet)
Rk = Fixed effect of Location (k = Sherpur Sadar, Nalitabari)
Tl = Fixed effect of season of birth (l = Summer, Winter)
Fm = Fixed effect of flock size (m = 5 group, 10 group, 15 group)
Eijklm = The residual error

RESULTS

Weight of lambs of different sex from birth to 1 year of age: Male and female have found some variations in body weight at different stages of age. The body weight of Jamuna basin lamb in male and female from at birth, 1, 3, 6 and 9 months of age were found 1.47±0.01 & 1.45±0.01, 3.59±0.06 & 3.56±0.07, 6.77±0.14 & 6.51±0.14, 10.29±0.31 & 9.26±0.41, 15.45±0.84 & 13.08±1.49 and 17.20±0.63 & 16.79±0.62 kg, respectively (Table 1). Mean birth weight of male was little higher than female and subsequently, the mean body weight of Jamuna basin lamb was higher in male throughout the experimental period (up to 9 months). It was found a significant influence ($p<0.05$) of sex (male and female) on the body weight at 6 months (10.29±0.31 and 9.26±0.41 kg) of age but variations were statistically insignificant in different sexes throughout the growing period except 6 month of age.

Weight of lambs of different litter size from birth to 1 year: Litter size is also an important parameter for gaining body weight at different stages of its lifetime. The body weight of Jamuna basin lamb for single, twin and triplets were 1.51±0.22, 1.44±0.13 and 1.24±0.14 at birth; 3.93±0.98, 3.26±0.78 and 3.23±0.98 at one; 6.88±0.13, 6.35±0.15 and 6.15±0.37 at three; 10.14±0.31, 9.40±0.41 and 9.62±1.00 at six and 14.74±0.99, 14.91±1.14 & 12.65±1.07 at nine and 18.45±4.32, 17.37±4.17 and 17.38±4.23 kg at twelve months of age (Table 2). Differences of body weight in different litter sizes were found significant at birth ($p<0.01$), 1 month ($p<0.01$) and 3 months ($p<0.05$) but statistically no significant differences were found at 6 month as well as up to 9 months of age. It was found a lower body weight of triplet lambs throughout the experimental period. Highest body weight found in single lamb up to 6 months of age but the final body weight of twin lambs showed the highest body weight (14.91±1.14) at 9 months.

Weight of lambs of different season from birth to 1 year: The body weight in different seasons of Jamuna basin lamb from at birth, one, three, six, nine and twelve month of age were 1.46±0.01 & 1.45±0.01, 5.50±0.16 & 5.10±0.08, 7.06±0.18 & 6.51±0.12, 10.07±0.28 & 9.43±0.47, 14.74±1.33 & 13.98±0.22 and 18.33±4.24

Table 1: Weight of lambs of different sex from birth to nine month of age

	Weight (Mean±SE)			
Age	Male	Female	Overall	Level of significance
At birth (Month)	1.47±0.01 (196)	1.45±0.01 (164)	1.46±0.01 (360)	NS
1	3.59±0.06 (188)	3.56±0.07 (162)	3.58±0.05 (350)	NS
3	6.77±0.14 (128)	6.51±0.14 (108)	6.65±0.10 (236)	NS
6	10.29±0.31 (125)	9.26±0.41 (98)	9.84±0.25 (223)	*
9	15.45±0.84 (113)	13.08±1.49 (87)	14.74±0.74 (200)	NS
12	17.20±0.63 (113)	16.79±0.62 (87)	17.00±0.63 (200)	NS

NS = Means not significant; * = Means significant at 5% level of probability, values in the parenthesis bracket indicate number of lambs

Table 2: Weight of lambs of different litter size from birth to 1 year

Age	Weight (Mean±SE) Single	Twin	Triplet	Level of significance
At birth (Month)	1.51±0.22 (168)	1.44±0.13 (174)	1.24±0.14 (18)	**
1	3.93±0.98 (168)	3.26±0.78 (168)	3.23±0.98 (14)	**
3	6.88±0.13 (127)	6.35±0.15 (106)	6.15±0.37 (3)	*
6	10.14±0.31 (115)	9.40±0.41 (81)	9.62±1.00 (11)	NS
9	14.74±0.99 (112)	14.91±1.14 (78)	12.65±1.07 (11)	NS
12	18.45±4.32(112)	17.37±4.17(78)	17.38±4.23(11)	NS

NS = Means not significant; ** = Means significant at 1% level of probability, * = Means significant at 5% level of probability, values in the parenthesis indicate number of lambs

Table 3: Weight of lambs of different season from birth to 1 year

Age	Weight (Mean±SE) Winter	Summer	Level of significance
At birth (Month)	1.46±0.01 (82)	1.45±0.01 (278)	NS
1	5.50±0.16 (63)	5.10±0.08 (226)	*
3	7.06±0.18 (63)	6.51±0.12 (173)	*
6	10.07±0.28 (56)	9.43±0.47 (162)	NS
9	14.74±1.33 (54)	13.98±0.22 (160)	NS
12	18.33±4.24(54)	17.62±3.25(160)	NS

NS = Means not significant; * = Means significant at 5% level of probability, values in the parenthesis bracket indicate number of lambs

Table 4: Weight (kg) of lambs at different location from birth to 1 year

Age	Weight (Mean±SE) Sherpur (Char area)	Nalitabari (Hill area)	Overall	Level of significance
At birth (Month)	1.46±0.01 (180)	1.46±0.01 (180)	1.46±0.01 (360)	NS
1	3.59±0.07 (172)	3.57±0.07 (178)	3.58±0.05 (350)	NS
3	6.87±0.14 (115)	6.45±0.14 (121)	6.65±0.10 (236)	*
6	9.81±0.33 (104)	9.87±0.38 (114)	9.84±0.25 (218)	NS
9	15.10±0.84 (104)	14.20±1.49 (114)	14.74±0.74 (218)	NS
12	18.05±4.42(104)	16.72±4.11(114)	17.39±4.27(218)	NS

NS = Means not significant; * = Means significant at ($p<0.05$) level, values in the parenthesis indicate number of lambs

Table 5: Weight of lambs at different flock size from birth to 1 year

Age	Weight (Mean±SE) (Groups) 5	10	15	Level of significance
At birth (Month)	1.44±0.01 (79)	1.47±0.02 (137)	1.46±0.01 (144)	NS
1	3.69±0.11 (76)	3.56±0.08 (136)	3.50±0.07 (138)	NS
3	7.03±0.20 (55)	6.73±0.17 (95)	6.30±0.16 (116)	*
6	10.69±0.41 (45)	10.63±0.44 (84)	8.39±0.33 (102)	***
9	12.20±0.89 (43)	15.02±0.77 (74)	15.98±0.34 (99)	NS
12	17.20±0.63(43)	16.79±0.62(74)	17.00±0.63(99)	NS

NS = Means not significant; *($p<0.05$), ***($p<0.001$) level of significant; values in the parenthesis indicate number of lambs

17.62±3.25 kg in winter and summer, respectively (Table 3). Season (winter and summer) had a significant ($p<0.05$) influence on the weight of one month and 3 month of ages lamb. Although, there were little variations found in different seasons throughout the growing period but there were no statistically significant differences except one and three month of ages.

Weight of lambs at different location from birth to 1 year: The body weight of Jamuna basin lambs in char area and hilly area were 1.46 ±0.01 and 1.46±0.01, 3.59 ±0.07 and 3.57±0.07, 6.87±0.14 and 6.45±0.14, 9.81±0.33 and 9.87±0.38 and 15.10±0.84 and 14.20±1.49 and 18.05±4.26 and 16.72±4.11 kg, respectively at birth, one, three, six, nine and twelve month of age (Table 4). The effect of location was found significant difference ($p<0.05$ and $p<0.01$) in body weight at 3 and 12 month of age, respectively. Although, there were little variations found in different locations throughout the growing period but there were no statistically significant differences except three month of age.

Weight of lambs at different flock size from birth to 1 year: The body weight of Jamuna basin lamb in 5 animals group, 10 animals group and 15 animals groups were 1.44±0.01, 1.47±0.02 and 1.46±0.00; 3.69±0.11, 3.56±0.08 and 3.50±0.07; 7.03±0.20, 6.73±0.17 and 6.30±0.16; 10.69±0.41, 10.63±0.44 and 8.39±0.33; 12.20±0.00, 15.02±0.77 and 15.98±0.34 and 17.20±0.63, 16.79±0.62 and 15.51±0.48 kg, respectively at birth, 1, 3, 6, 9 and 12 months of age (Table 5). The effect of flock size had highly significant ($p<0.001$) on the

Table 6: ADG (g/d) of different location, season and litter size from birth to 1 year

	Parameters									
	Location			Season			Litter size			
Age (Month)	Char (Mean±SE)	Hilly (Mean±SE)	Level of significance	Winter (Mean±SE)	Summer (Mean±SE)	Level of significance	Single (Mean±SE)	Twin (Mean±SE)	Triplet (Mean±SE)	Level of significance
1	119.33±2.25 (172)	119.00±2.20 (178)	NS	183.33±3.02 (77)	170.00±1.82 (273)	NS	131.00±3.58 (167)	108.67±2.81 (169)	107.67±2.42 (14)	***
3	73.89±2.17 (115)	71.67±2.45 (121)	NS	98.44±3.18 (62)	72.33±1.88 (174)	*	76.44±3.01 (126)	70.56±3.14 (107)	68.33±0.10 (13)	NS
6	54.67±4.03 (54)	54.83±4.67 (34)	NS	55.94±3.70 (56)	52.39±0.93 (32)	NS	56.33±0.85 (51)	52.22±4.87 (37)	53.44±0.08 (13)	*
9	54.59±2.30 (48)	52.59±3.60 (31)	NS	54.59±4.56 (50)	51.78±0.74 (30)	**	54.59±2.78 (46)	55.22±5.12 (48)	46.85±1.03 (12)	NS
12	51.34±3.59 (48)	46.27±4.11 (31)	NS	50.30±4.24 (50)	48.27±3.25 (30)	**	50.55±4.32 (46)	47.59±4.17 (78)	47.62±4.232 (12)	*

Level of significant, *(p<0.05), *** (0.001); NS = Non Significant, Values in the parenthesis indicate number of lambs

body weight at six month of age. The effect of flock size had also significant in the body weight of three month (p<0.05) of age. Although, there were little variations in weight at different flock size throughout the growing period but statistically there were no significant differences.

ADG (g/d) of different location, season and litter size from birth to 1 year: The ADG of Jamuna basin lambs in char and hilly areas were found 119.33±2.25 &119.00±2.20, 73.89±2.17 &71.67±2.45, 54.67±4.03 &54.83±4.67, 54.59±2.30 & 52.59±3.60 and51.34±3.59 & 46.27±4.11 g/day, respectively at one, three, six, nine and twelve month of age (Table 6).

ADG were not significant in char and hilly areas under the study. ADG for winter and summer season were 183.33±3.02 & 170.00±1.82, 98.44±3.18 & 72.33±1.88, 55.94±3.70 & 52.39±0.93, 54.59±4.56 & 51.78±0.74 and 50.30±4.24 & 48.27±3.25 g/day, respectively at same ages. Season (Winter and Summer) had a significant (p<0.05) influence of 3-month (98.44±3.18 and 72.33±1.88), 9-month (54.59±4.56 and 51.78±0.74) and 12-month (50±4.24 and 48.27±3.25) g/day on ADG. ADG for single, twin and triplet were 131.00±3.58, 108.67±2.81 & 107.67±2.42, 76.44±3.01, 70.56±3.14 & 68.33±0.10, 56.33±0.85, 52.22±4.87 & 53.44±0.08, 54.59±2.78, 55.22±5.12 & 46.85±1.03 g/day, respectively at same ages. The effect of litter size had highly significant (p<0.001) on ADG at birth to one month of age. Litter size had also significant (p<0.05) effect on ADG at 6 and 12 month of age.

Although, there were little variations in ADG but there were no statistically significant differences at the age 3 and 9 month.

Mortality of lambs in the study area: Average mortality rate was found 13.5%. Highest mortality was 31% at the age of 3 month and no mortality was at 9 month of age. Mortality rate of char, hilly area, summer and winter season was 10.1, 12.1, 7.32 and 15%, respectively. Similarly 5, 10 and 15 group flock size was 13.44, 28.24 and 33.13%, respectively. Mortality rate of single, twin and triplet lambing was 12.5, 15.5 and 33.33%, respectively (Table 7). Mortality rate was found significant at one (p<0.05) and 3 months (p<0.01) of age. Similarly, a significant differences in lamb mortality was found in char (p<0.05) and hilly areas (p<0.01). In case of flock size, significant differences of lamb mortality were found in 5 animal (p<0.05), 10 animal (p<0.01) and 15 animal (p<0.01) groups, respectively. Significant differences were also found in mortality of single (p<0.05), twin (p<0.01) and triplet (p<0.01) lambs, respectively.

Table 7: Mortality of lambs in the study area

Parameters	No. of lamb died	Died (%)	Mean±SEM	Level of significance
Age (Month):				
1	6	17	2.00±0.81	*
3	11	31	2.75±0.28	**
6	2	6	1.00±0	NS
9	0	0	0	NS
12	0	0	0	NS
Location:				
Char area	26	10.1	3.71±0.85	*
Hilly area	34	12.1	4.86±0.007	**
Season:				
Summer	18	7.32	3.60±0.07	*
Winter	43	15.0	6.14±0.007	**
Flock size:				
5 animals	21	13.44	4.20±1.88	*
10 animals	61	28.24	10.17±1.30	**
15 animals	56	33.13	7.00±0.35	**
Litter size:				
Single	68	12.5	8.50±4.34	*
Twin	84	15.5	12.00±1.31	**
Triplet	8	33.33	2.66±0.07	**

Level of significant, *(p<0.05); **(p<0.01); NS = Non Significant

Causes of death in different diseases: Based on the data obtained from flock monitoring, the death percentage of lamb was calculated. Death of lamb due to diarrhoea, bloat and pneumonia was found 40, 20 and 11%, respectively, during study period. Death was also found 3-6% for other diseases mentioned in Table 8.

Table 8: Causes of death in different diseases

Causes of death	No. of lamb died	Percentage
Diarrhoea	14	40
Bloat	7	20
Pneumonia	4	11
Lower body weight	2	5
Nutritional deficiency	1	3
Biting (dog/fox)	2	6
PPR	2	6
Nitrate poisoning	1	3
Dead unknown	2	6

DISCUSSION

Effect of sex on growth performance: It was investigated from the present study that the male lambs were found heavier than females from birth to nine month of ages. Farmers also took extra care which was another reason for their better growth performance. At birth, the body weight of male and female (1.47±0.01 and 1.45±0.01 kg) were very similar. Average birth weights of Jamuna basin lamb in Bangladesh were 1.5 and 1.3 kg for male and female[11] which was very similar with the present study (1.47 and 1.45 kg). Taye *et al*.[12] reported that in Washera sheep mean weight of birth, 1, 3, 6 and 9 month of male (2.72, 7.11, 12.77, 16.64 and 21.21 kg) and female (2.65, 7.08, 12.20, 15.81, 18.89 kg) which was higher than the present study. It might be due to adult body weight of Washera sheep was heavier than Jamuna basin sheep. Major findings indicated that male lambs had usually higher weight at birth and grew faster than females[13] while few had shown that there was less general effect of sex on body weights. Hormonal differences between the sexes may be the cause of higher body weight and growth in male lambs. El-Sabagh *et al*.[14] stated that the difference in sex hormones and sexual dimorphism affects feed intake, growth rate and feed efficiency. In this study, the general trend of sex variation was evident at later ages of lambs which agreed with the findings of Hassen *et al*.[15] who reported the importance of sex as lambs get older in Ethiopia.

Litter size on growth performance: Single (1.51±0.22 kg) and twins (1.44±0.13 kg) lambs were heavier body weight at birth than the triplet (1.24±0.14 kg) (Table 2). Single lamb get more space for gesture and posture in the maternal uterus than twin or triplet lamb might be influenced the birth weight of the offspring as liter size increases individual birth weights decline[16]. Prakash *et al*.[17] reported that the effect of litter size of lambs significantly affected the growth performance in Garole sheep. The effect of litter size on growth traits showed consistency as the age of lambs advanced. Single born lambs had higher body weight compared to twins and triplets at all stages. The higher litter size or percentage of multiple births twins (48%) and triplets (5%) might be resulted in lower body weights of individual lambs at birth but had improved the overall lamb outputs. Generally, single births attained higher body weights and ADG than twin and triplets. The higher body weights and overall ADG of single births was due to the fact that they were the sole consumers of their dam's milk while twins and triplets compete for limited milk of their dams[13].

Effect of season on growth performance: Generally, higher birth weight and subsequent weights were found during the winter (Table 3). This could be associated with seasonal nutrient fluctuations and feed selection behaviour of sheep[13]. The influence of season on birth weight, weight at various ages and ADG had been well documented at station[18] and under smallholder management systems[15]. They reported higher body weights and ADG of lambs during dry season and part of light rainy seasons was consistent with other reports[18]. On the other hand, higher body weight and faster gain during early winter at some ages was partly due to better body reserves of dams at the end of summer season and the associated higher milk yield. It had been noted that during late winter lambs born with higher weight and usually grew faster due to feed flushing of the dams during early winter season[13]. Yilmaz *et al*.[19] noted seasonal differences on weight of lambs due to differences in environmental temperature and prenatal effects during gestation period. According to Gbangboche *et al*.[20] effects of heat stress affects feed intake and consequently body weights among indigenous lambs in sub-tropical ecological zones. On the other hand, quality of feed and variations in feed composition as well as milk yield of dams was factors that had frequently been reported to influence lamb weight during early growth period.

Effect of location on growth performance: It was observed from Table 4 that the lambs born in char area were heavier than hilly area. The variation in growth traits among different locations also concurred with previous results that had compared performance of sheep in different locations[21]. They showed significant difference between Horro and Menz lambs in birth weight (2.4 vs. 2.1 kg). In the present study the lambs born in char area showed higher growth rate indicating that feed was available for lambs and lactating ewes. The variation in growth performance between these areas might be an indication that lambs in char area had better management at early age. The difference in growth performance between areas might also be a positive feature to improve the management practice. The effect of location on growth performance was also observed by Taye *et al*.[12]. The variation recorded in growth performance between char and high land areas could be an asset and gave a

direction to improve the genetic potentials of local sheep with a long-term selection effort. Hassan and Talukder[11] observed difference of birth weight and body weight gain of the lamb of three ecological zone of Bangladesh which was closer to the present study.

Effect of flock size on growth performance: It was found from Table 5 that the body weights of 5 animal's groups were higher at three and six month of age than other groups. Farmers could take care of the sheep properly in small farm size. A smaller number of strong animals could be worth more than a larger number in poor condition. A small sheep farming concerned calls for dedication, discipline and a genuine concern for the animals. A small number of well-managed, productive animals might make more money than a larger number of animals in poor condition. After 9 month, flock of 10 sheep group showed consistently higher weight gain than 5 groups and lower than 15 groups. Average flock size (10 groups) can well managed by a rural family, compared to wastes of labor in small (5 sheep) groups and difficult to manage 15 sheep groups regarding housing, concentrate supplementation, forage and tree leaves supplementation during winter. On the other hand, Gizaw *et al*.[22] revealed that large flock size usually had extensive sheep breeding practices and generated large number of lambs for sale that was different from our study. In case of large flock (15 animals groups) weaker ones could not get sufficient concentrate and thus inadequate nutritional supply would result in reduction of growth and reproductive performance. This effect of under-nutrition causes disruption in endocrinology thereby lowering the overall flock productivity of sheep. The results of this study were supported by Paez Lama *et al*.[23] who reported that paying more attention to rearing management systems, improve health condition and supply adequate nutrients could improve flock performance.

Average daily body weight gain: It was found that average daily gains ranging from 119.33-183.33 g/days at the end of the first month of age. These values were agreed with the observation of Gbangboche *et al*.[20]. Lamb born in char area had higher daily weight gain than hill area. ADG of winter born lambs was better than summer born lambs because suitable environment, plenty of feed available at this time. Similar observation was found by Gemiyo *et al*.[13]. In summer (mostly from June to September), both area were affected by flood. This causes scarcity of feed that leads to the lower ADG than winter season. Male lambs were superior over their female contemporaries but sex effect was not found significant in this study. Gemiyo *et al*.[13] also reported a higher average daily gain of male than female which was similar to this study. Single lambs had a heavier ADG at birth to 1 month than twins. In this period growth performance in single, twin and triplet was better than other periods due to get mother milk which was very nutritious. Farmers also had taken extra care which was another reason for their better growth performance. On the other hand, single-born lambs grew faster at all ages than their multiple contemporaries because single born lambs were the sole users of milk from their ewes. This result was in agreement with the reports of Mishra *et al*.[24]. Feeding strategy and other managemental practices also influence the ADG. Sarkar *et al*.[25] stated that the average ADG of native kids were 53.22, 67.51, 84.31 and 74.79 g/d at different feeding strategy of lactating doe. Kawsar *et al*.[26] studied the ADG of BB kids and found a comparative lower ADG with lower supplementation of concentrates to the lactating does. Habib *et al*.[27] stated that castration has an influencing effect on daily weight gain and they found a faster ADG in castrated male kids (76.33 g/d) over uncastrated kids (62.72 g/d).

Mortality of lambs in the study area: The number of lambs born per ewe was certainly an economically important trait in a commercial sheep enterprise. Knowledge of when and how lamb mortality occurs could be helpful to keep the mortality rate to be a minimum. The mortality rates were found 11.11%. Hassan and Talukder[11] found average lamb mortality (12.4%) in native sheep which was higher than present study. Nimbkar *et al*.[28] found 13.8% mortality in Garole sheep of India which was higher than present study. Mortality observed in the study was relatively high after 3 month of age compared for other periods (Table 7) due to weaning shock of lambs. Better management practices before lambing and care of lambs from birth to four months of age could play an important role in reducing mortality. It was expected that lambs weaning with lower weights would have less growth rate by the effect of weaning stress and poor quality of native pasture. The mortality was higher at this period due to mis-mothering, low birth weight, age of ewes, immunity acquired by the neonate through colostrum, suffers from malnutrition, weak resistant and affected by diseases. Mortality rate was higher in hilly area than char area due to lack of green grass, better management and geographical location. Mortality rate of winter season (15%) was higher than summer (7.32%). The seasonal differences in mortality might be the result of severe drought conditions leading to fodder shortage in the study areas. Triplet mortality was higher than single and twin lambing due to lacking of mother's milk and faulty management. This result was agreed with the result of Mustafa *et al*.[10]. Fifteen group flock size mortality was higher than five and 10 group

flock due to lacking of sufficient floor space, adequate nutrition and weak management. Total mortality was found 23% at neonatal stage. The neonatal period was the most vulnerable time in the life of a lamb with almost half of all pre-weaning mortalities occurring on the day of birth[39]. The causes of neonatal death was poor management, poor mothering of ewes, pneumonia and other infectious diseases.

Causes of death: Hasan and Talukder[11] reported that death was 23 and 15.4% due to diarrhoea and pneumonia of Jamuna basin sheep which is not agreed with the present study. The causes of death are more difficult to diagnose without a full necropsy of lambs. Lamb mortality could be greatly reduced by slight modifications of lambing management. Metabolic disorders and diseases are certainly the prevalent causes of death. Mortality rate was higher in diarrhoea disease. Pneumonia and gastroenteritis were the major diseases which caused the highest mortality in lambs[10] which was not similar to the present study. Proper feeding of the pregnant ewes minimizes the scope of lamb mortality. More than 3-4% of all mortality had its causes in faulty or inadequate management of ewes and lambs. Simple improvements in the overall management of the flock before, during and after lambing would be greatly reduced the number of deaths. There was no miracle drug for a dead lamb, practically none for a weak lamb and if the lamb is healthy, it does not need any drug. Reducing lamb mortality to an acceptable level should be up to 4 to 5% of any sheep producer is desirable.

CONCLUSION

It is revealed from the study that sex of lamb, litter size, season, location and flock size used in the study are important source of variation for growth traits in Jamuna basin lambs. Simple improvements in the overall management of the flock before, during and after lambing would be greatly reduced the number of deaths. So, the production performance of lamb is better in semi-intensive rural field management system of Bangladesh.

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