Research Articles

Multi-farm evaluation of morphometric, reproductive and productive traits of Jamuna basin indigenous and Muzaffarnagari cross breed sheep of Bangladesh

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Abstract

The study aimed to determine the more performance sheep between Jamuna basin indigenous and Muzaffarnagri cross breeds with respect to their morphometric, reproductive and productive traits for farmers' choice of Bangladesh. Farm visit, routine monitoring, spot observation and semi-structure questionnaire were used for field data collection. Morphometric traits like body weight (BWT), withers height (WH), heart girth (HG) and body length (BL) were studied both on matured rams and ewes of Jamuna basin indigenous and Muzaffarnagri cross breed sheep and scrotal circumference (SC) and testicular length (TL) on mature rams. Muzaffarnagri cross sheep had significantly higher body weight than Jamuna basin indigenous sheep. The ram traits were dominated over female except Jamuna basin indigenous ewes had higher body length than male. The age at first service (AFS), gestation length (GL), age at first lambing (AFL), lambing interval (LI) and post-partum interval (PPI) were found significantly shorter in Jamuna basin indigenous ewes than those of Muzaffarnagari cross breed ewes. The multiple births and number of female lambs were higher in Jamuna basin indigenous than those of Muzaffarnagari cross breed sheep. In reverse, single birth and number of male lambs were higher in Muzaffarnagari cross breed sheep than those of Jamuna basin indigenous sheep. The birth weight, 30 and 60 days weight, average daily gains at (0-30) and (30-60) days were significantly higher in Muzaffarnagari cross breed lambs than those of Jamuna basin indigenous lambs. Male lambs were dominated in weight and daily gain over female lambs in all age groups and breed difference were significant. Although Jamuna basin indigenous is comparatively more prolific in nature in reproductive traits but morphometric and productive features of Muzaffarnagari cross breed sheep may generate more money to fulfill the farmer's dream.

Keywords: Bangladesh, Sheep, Morphometry, Reproduction, Production

Introduction

Bangladeshi smallholder farmers keep considerable numbers of livestock in their mixed agricultural production system. Livestock contributes 1.47 percent in Gross Domestic Product (GDP) and 13.46 percent GDP share in Agriculture. Livestock contributes around 3% of the national GDP and provides 15 percent of total employment (BER 2017). About 75% people rely on livestock to some extent for their livelihood. About 50% of the total population of Bangladesh is indirectly employed and 20% directly employed in livestock for their livelihoods (DLS 2019). In livestock population, sheep stands as third in rank after cattle and goat. Present reports says, there are 35.37 million of sheep in Bangladesh (DLS 2019). They are mainly indigenous type sparsely distributed throughout country with a relatively higher concentration in several agro-ecological zones; coastal regions, barind tracts, north-eastern wetlands, sundarban-delta regions and Jamuna river basin areas (Pervage et al., 2009). Now a day, an Indian exotic Muzaffarnagari cross breed sheep is being popular for its body conformation and faster growing quality to the farmers of western border areas viz. Meherpur, Choadanga and Chapainawabganj districts of Bangladesh (Sardar 2016). Farmers in a few from other districts also interestingly stockpiles this sheep breed in marginal numbers to increase their profit margins. The name Muzaffarnagar sheep came after the place of origin of the breed. The breed is also known as Bulandshahri native to the Muzaffarnagar, Bulandshaher, Meerut and the Bijnor districts of Western Uttar Pradesh, India. This mutton type breed is well adapted even in irrigate areas (Sheepfarm 2019).

Farmer keeps sheep for trade and meat consumption in their households where gross income is determined in terms of body weight or size of the sheep (Gemeda et al., 2007). They provide their owners with a vast range of products and services such as immediate cash income, meat, skin, manure, risk management and social functions (Ashebir et al., 2016). The sheep productivity contributes to the smallholder's as well as national economy (Gatew 2014). Reproduction determines the productivity through the expansion of animal genetic resources; reproductive performance is therefore a good measure (Salifu 2014) or key factor (Bilgin et al., 2004) of productivity. Birth and weaning weight of lambs are important components of overall ewe productivity because of their effect on lamb survival, lamb growth rate and total lamb market weight (Iman and Slyter 1996).Therefore, a better performance breed is prerequisite to achieve the livestock production potential (Matika et al., 2003; Isani et al., 2012). Moreover, breed characterization is the first approach prior to expansion and sustainable use of animal genetic resources. Although morphometric traits are not exclusively reliable, these play complementary role in the first phase of a breed characterization (Gizaw et al., 2007; Parés i Casanova 2009).

Many researchers undertook several studies on phenotypic characteristics, reproductive performance, growth and wool production of different regional native sheep of Bangladesh (Pervage et al., 2009; Hassan and Talukder 2011; Islam et al., 2018). According to Pervage et al., (2009) Jamuna region sheep was comparatively better in reproductive performance than other regional sheep like Coastal and Barind sheep. Furthermore, Sardar (2016) underwent for an introductory study on Muzaffarnagari cross breed sheep available in Bangladesh. Therefore, the present study was aimed to compare more performance sheep between Jamuna

basin indigenous and Muzzaffarnagari cross breeds with respect to morphometric, reproductive and productive traits for farmer's choice

Materials and Methods

Study site: For conducting this study, Gopalpur and Bhuapur upazillas under Tangail district and Mojibnagar and Meherpur sadar upazillas under Meherpur district were purposively preferred for the common rearing of Jamuna basin indigenous and Muzaffarnagari cross breed sheep, respectively. The study areas are located 70 to 80 km and 410 to 420 km away from research station, respectively. Geographical locations of these agro-ecological study areas are Gopalpur (24.5583^{o}N 89.9167^{o}E), Bhuapur (24.4583^{o}N 89.8667^{o}E), Meherpur Sadar (23.7750^{o}N 88.6417^{o}E) and Mujibnagar (23.39^{o}N 88.36^{o}E). These areas are covered by annual average precipitations of about 1872mm (Tangail district) and 1467 mm (Meherpur district).

Sample size calculation: Sample size were calculated using a formula, $n = N/1+ N (e)^{2}$, (Yamane (1967:886), Where n is the sample size, N is the population size and e is the level of precision. As per official record, there were 20874 sheep population in study areas. At 95 percent confidence level and P = .5, the assumed sample size was 392 (392.44). However, we selected 426 animals randomly for the present study and were categorized by different ages (Table 1).

Farms and animals selection: Forty (n = 40) Jamuna basin sheep farms and fifteen (n = 15) Muzaffarnagari cross sheep farms were selected on random basis from Local Government Upazilla Livestock Office record books. Farms more than 5 indigenous sheep and 20 Muzaffarnagari cross sheep breeds with short distance and easy communicable from upazilla centre were selected for interviewing and data collection. About 2 - 3 farms were also selected in similar way as reserves that were supposed to be interviewed only when a respondent was unavailable. About 1.5 - 5 years aged rams and ewes, 6-12 months aged pubertal ewes and 0-60 day's old lambs were selected for current study.

Animal management: Farmers herd their sheep in mixed aged group under semi-intensive system. Usually they graze their sheep on road side grasses or fellow lands and tree leaves, offer sufficient clean water for 3 - 4 times a day with or without unformulated scanty rice gruel and bran. They also graze them grazed on communal grazing land during crop harvesting period. They sheltered their animals against predator and theft at night-time in a separated or common house of other domestic animals.

Table1. Categorization of experimental animals by different ages

Breed breeds	Farms (n)	Type and number of sheep				
		Mature rams (1-5 year)	Pubertal ewes (6-12 months)	Mature ewes (1-5 year)	Lambs (0 - 60d)	Total (n)
Jamuna basin indigenous	40	15	26	80	129	250
Muzaffarnagari cross	15	15	26	40	95	176
Total	**55**	**30**	**52**	**120**	**224**	**426**

Preparation of interview schedule: Based on objectives of the study, simple, direct and easy understandable semi-structured interview schedule were prepared with close and open forms of questions. Appropriate scale was used for measuring all studied variables whenever necessary. The draft schedule was pre-tested interviewing with three field sheep farm owners to identify faulty questions and actual situation. The necessary modifications were done on basis of pre-testing results and the questionnaire was then multiplied by printing its final form.

Farmer's visit: Primary visit were done to facilitate introduction with farmers, contact information and farms locations by the assistance of a Veterinary Filed Assistant (VFA) of respective livestock office. Then other regular visits were performed for taking all important records. Interviews were conducted during farmerís leisure period for limited number of animals (1 to 3) to minimize ownerís memory biasness, obtain accuracy and reliability of data. Respondents sometime asked about keeping of written documents if any.

Data collection: Considering the far distance between study areas, the two breeding seasons of six months from October - March, 2018 and 2019 were included for close monitoring and data collection. The morphometric traits viz. BL, HG, WH from adult (1.5 to 5 years) male and female and scrotal circumference (SC) and testis length (TL) from male were measured using a standard measuring tape in farmerís house or in grazing fields. Body length was measured from tail base to point of brisket. Body weight (BWT) of adult animals was calculated according to a formula by Khan et al., (2004). The reproductive traits such as Age at first service (AFS), gestation length (GL), age at first lambing (AFL), lambing interval (LI) and post-partum Interval (PPI) were determined mostly on the basis of farmers recalled and records if there was. After ewe parturition, birth date, birth weight, type of birth, sex of lamb records were taken within 24 h from birth. Lamb weights were taken using a portable electronic scale (WeiHeng, MAX: 50 kg d: 10gm). Young lambs were suckled freely and remained with their mothers for 24 h up to weaning under the same management condition. Lamb weights were further taken at 30 and 60 days aged. Average daily gain (ADG) was estimated from birth to 30 days and 30 to 60 days of age.

Data analysis: The data were analyzed statistically using Microsoft Excel 2010. First the data were carefully tabulated to excel sheets as per nature of data sets. Then the means (±SE) were determined using descriptive statistics and compared using t-Test, the values were considered significant ($P < 0.05$).

Results

Morphometric traits: The estimated body weight and morphometric features of Jamuna basin indigenous and Muzzaffarnagari cross breed rams and ewes are shown in Table 2. Muzaffarnagari cross breed ram had significantly higher BWT, WH, HG, BL, SC and TL than those of Jamuna basin indigenous ram. Similarly BWT, WH, HG and BL of Muzzaffarnagari cross breed ewes were also significantly higher than those of Jamuna basin indigenous ewes. Irrespective of breeds, all morphometric traits of male were dominated over female. In Jamuna basin indigenous sheep, all traits were dominated over female, but HG and BL had significantly higher than those of female, while BWT and WH were not significant. In Muzzaffarnagari cross breed sheep, all male traits were significantly higher than those of female except BL.

Reproductive traits: The reproductive traits between Jamuna basin indigenous and Muzaffarnagari cross ewes are shown in Table 3. The observed values of age at first service (AFS), gestation length (GL), age at first lambing (AFL), lambing interval (LI), post-partum interval (PPI) were significantly longer in Muzaffarnagari cross ewes than those of Jamuna basin indigenous ewes. Types of birth (ToB) and sex ratio (SR) of the Jamuna basin indigenous and Muzaffarnagari cross lambs are shown in Table 4. Single birth was higher in Muzaffarnagari cross sheep breed than that of Jamuna basin Indigenous sheep. Conversely, multiple births were higher in Jamuna basin Indigenous sheep than that of Muzaffarnagari cross breed sheep.

Productive traits: The lamb growth traits such as birth weight, pre-weaning and weaning weight between Jamuna basin indigenous and Muzaffarnagari cross sheep are presented in Table 5. All growth straits were found significantly higher in Muzaffarnagari cross breed lambs than those of Jamuna basin indigenous lambs. Irrespective of breeds, male lambs showed significantly dominancy in weight over ewe lambs in all age groups. The average daily gains (ADG) of Jamuna basin indigenous and Muzaffarnagari cross breed lambs are presented in

Table 2. Variability of body morphometric traits in Jamuna basin indigenous and Muzaffarnagari cross breed sheep

Traits	Sex	Sheep Breeds	
		Jamuna Basin Indigenous (Mean ± SE)	Muzaffarnagari cross (Mean ± SE)
Body weight (kg)	Male	14.92 ^{NS} ± 0.92	50.48^{*b} ± 1.75
		8.48 - 19.88 (n = 15)	41.89 - 66.83 (n =15)
	Female	14.23 ^{NS} ± .0.29	35.35^{*b} ± 1.08
		11.17-17.42 (n = 34)	25.40 - 51.05 (n = 34)
Wither height (cm)	Male	46.80^{NS} ± 1.30	70.07^{*b} ± 0.67
		41 - 56^{NS} (n = 15)	66 - 76 (n = 15)
	Female	49.15^{NS} ± 0.31	65.65^{*b} ± 0.70
		45 - 52 (n = 34)	56 - 74 (n = 34)
Heart girth (cm)	Male	61.53a ± 1.23	90.33^{*b} ± 1.35
		51 - 69 (n = 15)	84 - 99 (n = 15)
	Female	57.88a ± 0.44	78.68^{*b} ± 0.95
		53 - 62 (n = 34)	69 - 91 (n = 34)
Body length (cm)	Male	43.33b ± 1.15	70.60^{*NS} ± 0.74
		37 - 49 (n = 15)	67 - 76 (n = 15)
	Female	51.65b ± 0.46	69.47^{*NS} ± 0.94
		45 - 57 (n = 34)	51 - 81 (n = 34)
Scrotal circumference (cm)	Male	18.20 ± 0.51	28.07* ± 0.61
		15 - 21 (n = 15)	23 - 31 (n = 15)
Testis length (cm)	Male	10.67 ± 0.45	15.53* ± 0.51
		8 - 14 (n = 15)	13 - 21 (n = 15)

SE: Standard Error; ^{a,b}Mean values with different superscripts in the same column are significantly different;
NS: Not Significant; *Breed effect: $p<0.05$

Table 6. The average daily gains were found significantly higher in Muzaffarnagari cross lambs than those of Jamuna basin lambs in both (0-30) days and (30-60) days age groups. Although male lambs were found dominated weight gain over female lambs in all age groups but were not statistically significant.

Table 3. Variability of Reproductive traits in Jamuna basin indigenous and Muzaffarnagari cross breed ewes

Reproductive Traits	Sheep Breeds	
	Jamuna Basin Indigenous (Mean ± SE)	Muzaffarnagari cross (Mean ± SE)
Age at First Service (AFS , months)	8.04 ± 0.13 7 - 9 (n = 26)	10.35* ± 0.24 8 -12 (n = 26)
Gestation Length (GL, days)	146.77 ± 0.22 142 -151 (n = 80)	148.95* ± 0.70 145 -169 (n = 40)
Age at First Lambing (AFL, days)	422.00 ± 5.80 360 - 570 (n = 80)	508.05* ± 5.35 417 - 569 (n = 40)
Lambing Interval (LI, days)	178.50 ± 0.74 150 -180 (n = 80)	188.25* ± 2.15 180 - 210 (n = 40)
Postpartum Interval (PPI, days)	26.36 ± 0.72 18 - 45 (n = 80)	48.35* ± 1.99 29 -74 (n = 40)

SE: Standard Error; *Breed effect: p<0.05

Table 4. Variability of birth types and sex ratio in Jamuna basin indigenous and Muzaffarnagari cross breed lambs

Production Traits		Sheep Breeds	
		Jamuna Basin Indigenous (Percent)	Muzaffarnagari cross (Percent)
Type of Birth (ToB)	Single	44.3 (n = 35)	89.3 (n = 75)
	Multiple	55.7 (n = 44)	10.7 (n = 9)
	i.Twin	48.1 (n = 38)	8.3 (n = 7)
	ii. Triplet	7.6 (n = 6)	2.4 (n = 2)
Sex Ratio (SR)	Male	41.9 (n = 54)	58.9 (n = 56)
	Female	58.1 (n = 75)	41 (n = 39)

Table 5. Variability of weights (kg) in Jamuna basin indigenous and Muzaffarnagari cross breed lambs

Growth Traits	Sex	Sheep Breeds	
		Jamuna Basin Indigenous (Mean ± SE, n = 20)	Muzaffarnagari cross (Mean ± SE, n = 15)
BWT(0d)	Male	1.34[a] ± 0.06	2.82*[b] ± 0.06
	Female	1.08[a] ± 0.06	2.61*[b] ± 0.06
BWT(30d)	Male	2.43[a] ± 0.14	7.24*[a] ± 0.16
	Female	2.26[a] ± 0.04	6.56*[a] ± 0.24
BWT (60d)	Male	4.72[b] ± 0.18	10.41*[a] ± 0.21
	Female	4.29[b] ± 0.24	9.35*[a] ± 0.28

SE: Standard Error; [a,b]Mean values with different superscripts in the same column are significantly different;
*Breed effect: p<0.05

Table 6. Variability of pre-weaning average daily gain (gm.) in Jamuna basin indigenous and Muzaffarnagari cross breed lambs

Average daily gain	Sex	Sheep Breeds	
		Jamuna Basin Indigenous (Mean ± SE, n = 15)	**Muzaffarnagari cross (Mean ± SE, n = 15)**
0-30 days	Male	$44.80^{NS} \pm 1.29$	$146.00^{*NS} \pm 7.76$
	Female	$43.47^{NS} \pm 2.34$	$130.00^{*NS} \pm 5.12$
30-60 days	Male	$66.93^{NS} \pm 3.39$	$110.73^{*NS} \pm 13.05$
	Female	$59.13^{NS} \pm 4.46$	$103.07^{*NS} \pm 11.29$

NS: Not Significant; *Breed effect: $p<0.05$

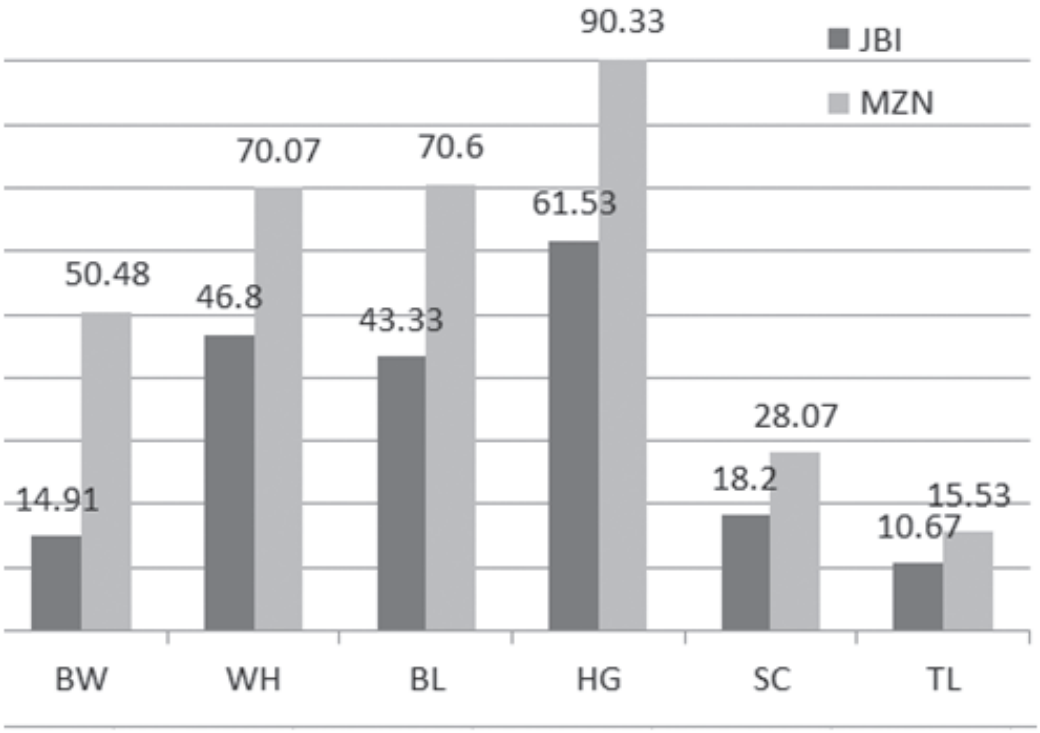

Figure 1. Body weight and biometric traits of rams

JBI-Jamuna basin indigenous, MZN-Muzaffarnagari cross, BW- body weight, WH-Withers height, BL-body length, HG- heart girth, SC- scrotal circumference, TL-testicular length

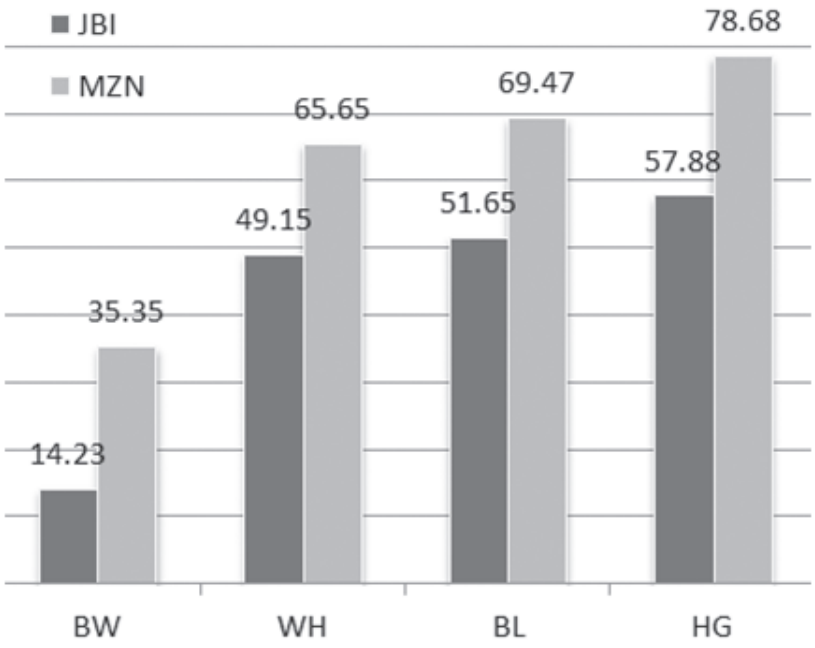

Figure 2. Body weight and biometric traits of female
JBI-Jamuna basin indigenous, MZN-Muzaffarnagari cross, BW- body weight, WH-Withers height, BL-body length, HG- heart girth

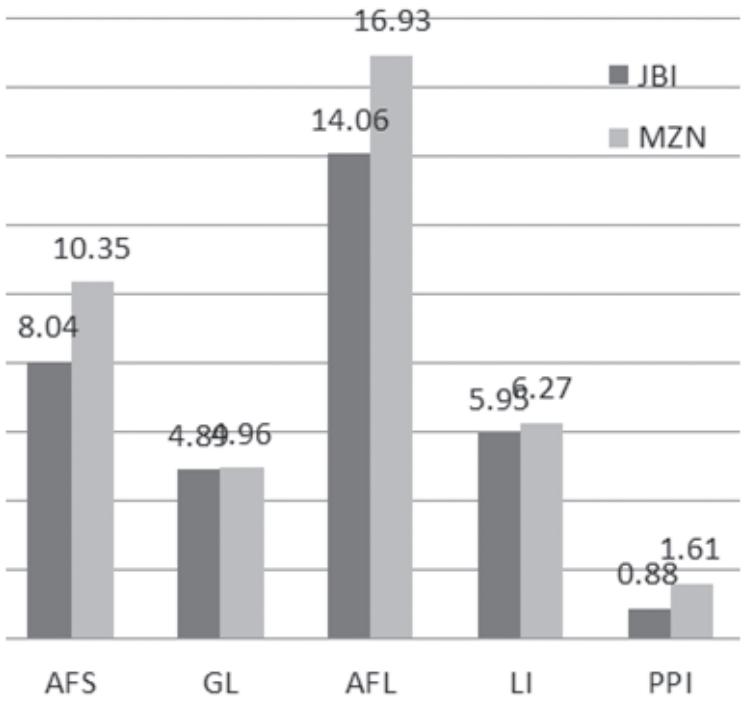

Figure 3. Reproductive traits (months) of ewes
JBI-Jamuna basin indigenous, MZN-Muzaffarnagari cross AFS- age at first service, GL-gestation length, AFL- age at first lambing, LI-lambing interval, PPI-postpartum interval

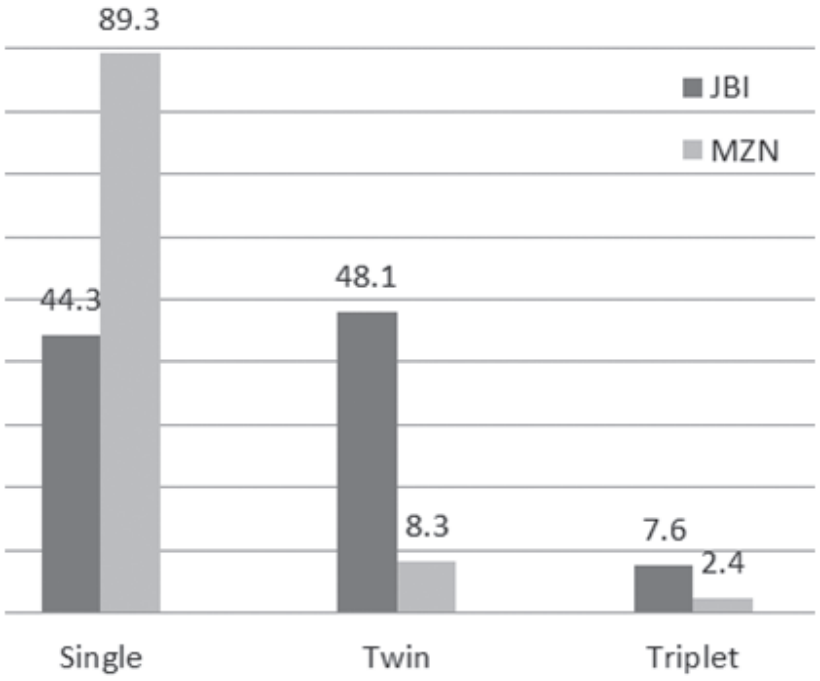

Figure 4. Type of birth of lambs, JBI-Jamuna basin indigenous, MZN-Muzaffarnagari cross,

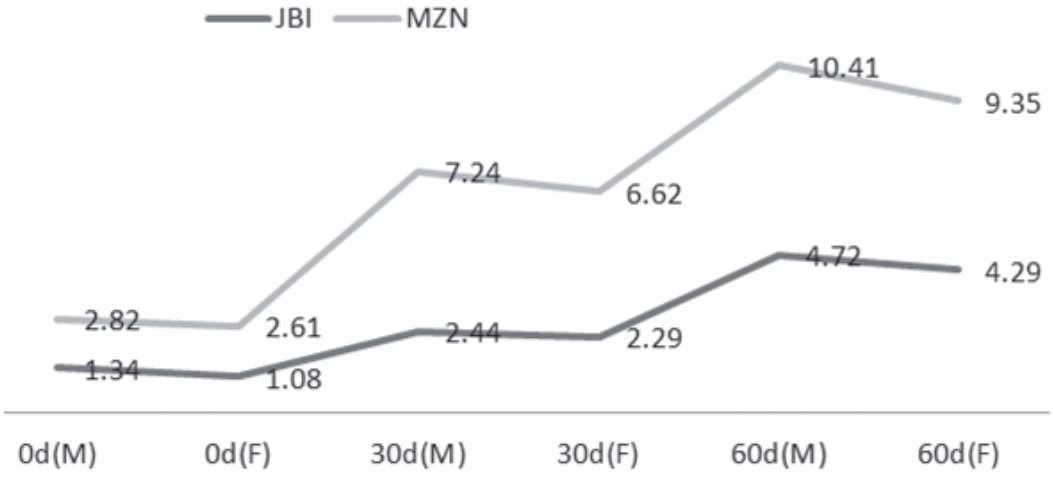

Figure 5. Lamb growth performance, JBI-Jamuna basin indigenous, MZN-Muzaffarnagari cross, d- day, M-male, F-female

Discussion

Morphometric traits: Body weight is a most important trait in animal husbandry due to selection criteria and economical profit (Cam et al., 2010). It is also essential for breeding, feeding, vaccination and drug dosages in livestock industry. Other morphometric traits such as body length, hearth girth, and withers height are also measured to assess live weight (Olawumi and Farinnako 2017), growth rate, feed utilization and carcass characteristics in farm animal (Brown et al., 1973). Livestock producer and buyers can achieve optimum production and value-based trading systems by correlating morphometric traits to growth characteristics (Birteeb and Ozoje 2012). However, scrotal circumference and testicular length are importantly correlated with breeding ability, body weight, and measurements; testicular traits therefore provide considerable opportunity to farmers and breeders for selection strategies on phenotypic basis (Waheed et al., 2011).

The current observations of ram and ewes body weight (BWT) of Jamuna basin indigenous sheep were supported by the findings of Islam et al., (2018) in native sheep at Jamuna river areas (17.84 ± 0.29 and 14.62 ± 0.11 kg in male and female sheep, respectively). These were also in line with the findings of Sowande and Sobola (2008) in African Dwarf sheep and Banerjee (2015) in Bengal sheep. The body length (BL) was in line with the observation of Hassan and Talukder, (2011) while the lower body length of rams and higher body length of ewes were to be similar reports of Islam et al., (2018). The weathers heights (WH) were complied with Pervage et al., (2009) in rams and ewes (47.71 ± 0.80 and 49.03 ± 0.49 cm respectively) of Jamuna river areas. The heart girths (HG) were to be similar with observations of Sowande and Sobola (2008) in African Dwarf sheep and Islam et al., (2018) in native sheep at Jamuna river areas (62.78 ± 1.35 vs. 58.4 6 ± 0.61 cm and 63.26 vs. 59.69 cm in male and female, respectively).

The increased morphometric traits in male and female of Muzaffarnagari cross breed sheep reflect that it is a larger, heavier and more meat producing breed than Jamuna basin indigenous sheep. These differences might be due to differences in growth rates, metabolic rates, growth and reproductive strategies together with genetic potentialities. However, the present BWT of rams and ewes of Muzaffarnagari cross sheep were agreed with the findings of Dinesh et al., (2006) in Indian Muzaffarnagari sheep (50.2 and 39.6 kg in ram and ewes, respectively), Yadav et al., (2013) in Bellary (43.0 and 31.8 kg) and Kenguri (52.6 and 35.9 kg) male and female sheep, respectively. The BL findings were in line with Indian Bellary and Kenguri sheep breed where male and female had 70.2, 74.7 and 65.6, 67.3 cm respectively (Yadav et al., 2013).The WH values were compromised with Bellary sheep as 74.5 and 68.9 cm (Yadav et al., 2013) and Sora sheep as 75.17 and 69.95 cm (Markovi? et al., 2012) in male and female, respectively. The current HG values for Muzaffarnagari cross breed sheep were agreed with Munjal sheep of 91.76 ? 0.73 and 83.78 ? 0.39 cm (Yadav et al., 2011) and the Kenguri sheep of 89.4 and 78.4 cm (Yadav et al., 2013) in male and female, respectively.

Generally male dominated over female in all body measurements (Birteeb et al., 2012). This is attributed to more concentration of thyroxine and male testosterone hormone which stimulates their growth. On other site, slower growth rate and mature size of female are attributed to effect of estrogen in restricting the growth of long bones of the body (Sowande and Sobola 2008). In the present study, male traits were

dominated significantly over female, except BWT and WH. This might be due to selling of rams before owing large size and to earn money by the farmers treating them as unproductive in flocks. Moreover, free mating and inbreeding might be another important issue. Male of Muzaffarnagari cross breed sheep dominated significantly over female in all body measurements except BL and this might be due to long time using of female for breeding in the flock.

The present SC and TL findings of Jamuna basin indigenous ram were slightly higher than the observations of Islam et al., (2018) in native rams of Jamuna river areas (16.72 ± 0.42 and 8.75 ± 0.19 cm for SC and TL, respectively). These traits were found significantly higher in Muzaffarnagari cross breed rams. These differences might be due to some genetic and non-genetic factors such as breed, season, birth type, birth weight and management that have been known to influence testicular development in later age. There were no reports on SC and TL of Muzaffarnagari cross breed rams; however, these traits of Yankasa rams (26.25 ± 0.70 and 15.19 ± 0.35 cm) by Ubah et al., (2017) and West African Dwarf rams (25.9 ± 0.15 and 15.8 ± 0.13 cm) by Akumbugu et al., (2018) were acknowledged the current findings.

Reproductive traits: The most important factor in determining profitability of a farm household or enterprise is reproduction. If an animal will not reproduce, it is worth no more than its current slaughter value (Larbi et al., 2014). Reproductive performance therefore, is of outstanding importance to small holders as well as commercial enterprises especially when meat production from young animals is the main aim. In general, the more intensive the meat production system, the more desirable the production of large numbers of young per breeding female (Sandford et al., 1982). Reproductive performances of sheep breeds are generally different. These differences need investigation for increasing the profitability of sheep production (Unal et al., 2006). Age at first service, gestation length, age at first parturition, lambing interval postpartum interval, birth types and sex were importantly investigated between two sheep breeds in the present study.

The age at first service (AFS) of Jamuna basin indigenous sheep in present record was in line with observation of Hassan and Talukder (2011) in native sheep (239.9 ± 35.5 days). This report was shorter than Muzaffarnagari cross breed sheep. These differences might be due to breed differences, geographical location and management practices. These differences also explicit that the Jamuna basin indigenous sheep reached at puberty earlier than Muzaffarnagari cross breed sheep and more reproductive potential breed. However, longer age of puberty was also reported by Edea (2008) and Amelmal (2011) in local sheep breeds were to be 10.8 ± 1.9 and 9.5 ± 1.4 months, respectively. Breeding season has great influence on age at first service of sheep. Holschbach et al., (2009) stated that six to eight months aged ewes showed estrus quickly while entered in breeding season due to effects of photoperiod on gonads. Arsoy and Sağmanlígil (2018) observed the highest and lowest data of estrous occurrence frequency in October and June-July, respectively.

The gestation length (GL) of Jamuna basin indigenous sheep in current study was in agreement with the reports of Pervage et al.,(2009); Zohara et al., (2014) in native sheep (151.48 ± 1.29 and 144.5 ±1.17 days, respectively). This report was shorter than the Muzaffarnagari cross breed sheep. These differences might be due to breed variation with delayed sexual

maturity and tend to carry heavier lambs. However, the longer gestation length of Muzaffarnagari cross breed sheep was agreed with the reports of Bradford et al., (1972); Patro et al., (2006); Addah and Karikari (2008) who reported longer gestation length of 149.90 ± 0.08, 148 and 149.54 ± 0.06 days in Merino, Djallonké and Costal Orissa sheep, respectively. Ronaldo (2020) reported that high temperatures and high nutrition levels may also shorten the gestation for few days. Breed, prolificacy, year and breeding season have significant effects on gestation length of the ewe (Shrestha and Heaney 1990). Mavrogenis (1992) reported prolificacy as a major tool of a breed towards shorter gestation.

The age of first parturition (AFP) of Jamuna basin indigenous sheep as current finding was in agreement with the findings of 432.72 ± 5.54, 409.8 ± 75.0 and 406.8 days by Pervage et al., (2009); Hasan and Talukder (2011); Islam et al., (2018), respectively. This report was shorter than Muzaffarnagari cross breed sheep. These differences might be due to breed differences and management practices. However, the higher age of first parturition in Muzaffarnagari cross breed sheep were reported by Edea (2008) and Amalmal (2011) in Bonga and local sheep breeds were to be 15.9 ± 3.1 and 14.77 ± 1.8 months, respectively. Many studies showed that only seasons (dryñwet) of year had effect on age at first lambing, other factors viz. year, litter size, birth weight, weaning age and weaning weight on age had no effects (Osuhor et al., 1997, Majid and Singh, 2011). The explanation for this effect might be availability of fodder and the lower level of parasite infestation while the opposite effects in the humid zone (Gatenby 1986; Gbangboche et al., 2004).

The lambing interval (LI) of Jamuna basin ewes in present study was very close to report of Islam et al., (2018) in native sheep (177.87 ± 0.79 days) of Jamuna river areas. On the other hand, this period was shorter than the reports by Pervage et al., (2009); Hasan and Talukder (2011) in Bangladeshi native sheep (188.6 ± 6.0, 221.13 ± 4.97 days), respectively and the current report of Muzaffarnagari cross breed sheep. These differences could be due to the different management practices, levels of genetic make-up and other factors not identified. However, these longer lambing intervals were in line with the findings of Edea, (2008), Belete, (2009) and Fsahastion et al., (2013) in Horro sheep (234 days), local sheep (236 days) and Washeria sheep (220 days), respectively. Lambing interval also depends on service period and gestation period. First trait is under controlled but the second trait is biological and controlled genetically. Although, London et al., (1994) and Clement et al., (1997) reported seasonal effect but Kabuga and Akowuah (1991) found non-significant effect on lambing interval in Djallonke^{x}Sahelian crossbred ewes in Ghana.

The current result on postpartum interval (PPI) of Jamuna basin indigenous sheep was in agreement with the findings of Hasan and Talukder (2011); Zohara et al., (2014) in the native sheep (30.5 ± 3.9 and 28.7 ± 7.24 days respectively). This report is shorter than Muzaffarnagari cross breed sheep. These differences might be due to breed specificity with less milk producing characteristic, prolific nature, early weaning and BCS of course. The longer PPI of Muzaffarnagari cross breed sheep were in agreement with the reports by Hunter and Lishman (1967) in German Merino sheep and Mandiki et al., (1990) in Texel sheep were to 47.5 and 44 to 57 days, respectively. Breeding season also might have influence on shorter postpartum interval. According to Dufour (1975), the ewes lambed in November had shorter postpartum interval than ewes lambed in May (18.0 and

87.1 days, respectively). First ovulation occurred by 25 ± 1.8 days in ewes lambed within breeding season (Feb. to April) and late-lambing female had first postpartum ovulation delayed until the next breeding season (Santiago-Moreno et al., 2001). According to Arsoy and Sağmanlígil (2018), the postpartum anestrous durations were 18.5 and 120.78 days in October and June-July, respectively.

The current report on higher multiple births and lower single birth of Jamuna basin indigenous sheep was in agreement with findings of Rahman and Huq (1976) and Sharma et al. (1999) in Bangladeshi native sheep and Garole sheep were to be 48 and 40 % of single, 52 and 58 % of multiple births (53 % twins and 5 % triplets) respectively. In other hand, higher single birth and lower multiple birth in Muzaffarnagari cross sheep was in line with reports of Begayt sheep (89.86 and 10.14 %) by Ashebir et al. (2016); Ile de France ewes (83.33 and 16.67 %) by Cirne et al. (2016) respectively. Multiple births are especially important in sheep producers (farmers and enterprises) not only for raising the production but also reducing the overhead cost. Genetic factors include breed differences and variability among individuals is mainly responsible for multiple births. Non-genetic factors viz. dam age and weight, nutritional status prior to breeding and during gestation also might have little influences (Edward and Robert, 1969). Increased frequency of desirable sex in breeding population helps in maximizing genetic gain by enhancing the intensity of selection. The farmers always prefer more females for further production than the males (Soundararajan and Sivakumar 2011). The Jamuna basin indegenous sheep in the present study had more female birth which was resemble with the findings of Siminska et al., (2008) in Pomeranian sheep was to be (53.5:46.5). This report was opposite in Muzaffarnagari cross breed sheep where male birth was higher than female. This report was in line with the observation of Ashebir et al., (2016) in Begayt sheep (50.33: 49.67). Harald (1979) reported that the variation in sex ratio might be affected by age of dam, nutritional level in flock, litter size, lambing seasons. According to José-Alfonso et al., (2017), the proportion of males born of spring and winter mating was significantly higher than summer ($p<0.05$) or autumn ($p<0.01$) conceptions.

Productive traits: Growth is the only outstanding important trait for sheep and other farm animals' production. Rapid growth of lambs is desirable because it is a way of improving sheep production efficiency (Unal et al., 2006). Therefore, growth has been investigated for many years. In sheep, growth traits such as body weight and average daily weight gains are important response indicators (Ganesan et al., 2013). In the present study, performances were measured with these traits between lambs of Jamuna basin indigenous and Muzaffarnagari cross sheep.

Birth weight of lambs is an early measurable trait which has a positive genetic correlation with further live weights (Csizmar et al., 2013). It has, therefore an important role in achieving a good sheep production (Petrovic et al., 2011) and speculated as a primary factor for the later growth and development of an organism (Petrović 2007). Lambs (male and female) birth weights in Jamuna basin indigenous in present study were in agreement with records of male and female lambs (1.2 ± 0.1 vs. 1.1 ± 0.2 kg) by Hassan and Talukder (2011); (1.34 ± 0.07 vs. 1.09 ± 0.04 kg) by Pervage et al., (2009) in native sheep of Bangladesh. These types of weights were lower than those of Muzaffarnagari cross breed lambs. These variations might be due to breed

differences with their genetic make-up. On the contrary, higher birth weights of Muzaffarnagari cross breed lambs were not in line with the results of Dass et al., (2017) and Mandal et al., (2003) who reported 3.52 ± 0.02 vs.3.1 ± 0.2 kg and 3.56 ± 0.06 vs. 3.37 ± 0.06 kg for male and female, respectively. These differences might be due to lambs' birth weights of pure Muzaffarnagari sheep breed. However, male and female lambs birth weights of Washera (2.72 ± 0.03 vs. 2.65 ± 0.03 kg) and Canarian sheep (2.9 ± 0.01 vs. 2.8 ± 0.01kg) reported by Taye et al., (2010) and Bermejo et al., (2010), respectively were agreed with the present findings. Breed and dam size, body condition score especially in gestation period (Laes-Fettback and Peters 1995) age, sex, litter size etc. (Notter et al., 1991) are known to influence birth weight. Management particularly of breeding ewes' greatly influences birth weight of lambs. Lambs birth weight even may differ in same breed with different managements. Overcrowding, feed crisis, health problems and heavy parasitic burden may also influence the birth weight of lambs. It is also observed in this study that male lambs had significantly higher birth weights compared to females.

In village conditions, lambs are allowed to go with ewes in nearer pasture lands apparently after a week and suckle their mothers until they become pregnant. In the meantime, ewes prepare for next oestrus cycle at or near 30 days' time of post-partum. Therefore, pre-weaning (30 days) weights are of importance to monitor lambs' growth in contrast to mothering ability of ewe, availability of milk in the udder, external environment, parasites and lamb management (Kumaravelu and Serma 2012). The results obtained from present study explored that lamb's sex and breed significantly influenced the pre-weaning weight. No literature could be traced for discussion and comparison of this parameter.

Weaning (60 days) weight is of great importance for farmers as well as sheep enterprises as determining the economic returns from sheep. In the present study, the weaning weights in Jamuna basin indigenous lambs were in agreement with weaning values of 3.6 ± 0.93 and 5.7 ± 1.03 kg in lambs of controlled and supplemented group, respectively (Zohora et al., 2014); 5.61 ± 0.06 kg in lambs of Jamuna river areas (Islam et al., 2018). These weaning weights were lower than those of Muzaffarnagari cross breed lambs. These differences might be due to breed potentiality, external environmental and lamb management factors. These higher weaning weights of Muzaffarnagari cross breed lambs were in line with reports by Csizmar et al., (2013) in Dorper lamb (11.35 ± 0.49 vs. 10.43 ± 0.34 kg for male and female, respectively) and Kuźnicka and Rant (2013) in a local sheep lambs (11.77 ± 0.50 kg).

The observed average daily gains (ADG) of Jamuna basin indigenous lambs in this study were in line with the observed ADG values of 42.6 ± 14.44 and 73.0 ± 13.35 gm. at pre-weaning ages (Zohora et al., 2014). These weight gains were lower than those weight gain in Muzaffarnagari cross lambs at 0-30 days and 30- 60 days of pre-weaning ages. These differences might be due to breed potentiality and nutritional factors. In Jamuna basin indigenous lambs, average daily gains were lower at 0-30 day's age group than 30-60 days age group. This report was agreed by Csizmar et al., (2013) who also found lower weight gain (280.60 ± 11.10 vs. 268.10 ± 21.00 gm at 0-30 days for male female, respectively than higher weight gain at 30-60 days (316.40 ± 13.80 vs. 280.56 ± 11.10 gm. for male and female, respectively) in Dorper lambs. These differences might be due to multiple birth, low milk yield, nutrition and management. In Muzaffarnagari cross breed lambs, average daily gains

were higher at 0-30 day's age group than 30-60 days age group. These differences might be due to single birth, more milk yield, nutrition and management. The results 127.8 ± 3.3 gm. (Mandal et al., 2003) and 135.59 ± 1.44 vs. 121.61 ± 1.30 gm. (male and female, respectively) (Dass 2018) of daily weight gains were in agreement with the present weight gain of Muzaffarnagari cross breed lambs at 0-30 days and 30-60 days age, respectively. Furthermore, Washeria (Taye et al., 2010) and a local sheep (Kuźnicka and Rant 2013) lambs were also revealed similar weight gain to present study. Many researchers (Bermejo et al., 2010, Mohammadi et al., 2010) found that male lambs grow faster than female Iambs before weaning. The present study affirmed these findings and indicated that part of the advantage of male lambs in pre-weaning weight gains results from the larger birth weights of males. Thus, heavier lambs at birth indicate rapid growth rates which are expressed prenatally and which result in faster growth rates

Conclusion

Shorter reproductive traits with increased percentage of multiple births and expected Theriogenological sex ratio of 50:50 for male and female lambs are indicative of prolific nature of Jamuna basin indigenous sheep. However, Muzaffarnagari cross sheep sheep might be the farmers' choice importantly based on morphometric and productive performances that directly involved with sale value and income sources. Therefore, emphasis should be given by researchers to produce Jamuna basin indigenous crosses following controlled breeding practices with a selective vigor and high performance ram or applying of ARTS with their high genetic merits to generate more money in fulfilling the farmerís dream.

Acknowledgement

The research was fully financed by the Bangladesh Bureau of Education and Information Statistics (BANBEIS), Ministry of Education, the People's Republic of Bangladesh for providing fellowship to the first author while undertaking the field study. The author is greatly indebted to Upazilla Livestock Officer and Veterinary Field Assistant of Gopalpur, Bhuapur under Tangail district and Mojibnagar , Meherpur sadar under Meherpur district to provide farm list in their record book and introducing the farmers. We are grateful to the staff of Projects and Lab MS fellow, particularly to Mr. Amit Shaha and and Jahir Rayhan for their interest in this research and support during the field work.

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