



Phenotypic characterization and production potentials of exotic goat breeds and their crosses in Rajshahi metropolitan area of Bangladesh

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Abstract

This study was conducted to investigate the morphology, morphometry and production performances of exotic goat breeds and their crossbreeds available at Boalia, Shahmokhdum, Rajpara and Matihar thana under Rajshahi metropolitan city. A total of 73 animals' information was collected from 39 exotic goat flock owners using a semi-structured questionnaire through interviewing of farmers, visual observation and on-spot measurement of the animals. Exotic goat breeds and their crosses were found predominantly higher (>93%) in Rajshahi Metropolitan areas where less than 7% Black Bengal goats were identified. In most cases, deviation of breed specific coat color due to crossing between different types of crossbreeds among the populations was noted. The genotype frequencies of Beetal, Kalahari, Sirohi, Jamunapari, Anglo Nubian and their crossbreeds and Black Bengal goats were found to be 50.68, 15.07, 13.70, 8.22, 8.22 and 4.11%, respectively. The average mature live weight (12 to 18 months) of those corresponding exotic genotypes in male and female respectively were found 46.88±5.66, 56.07±8.03, 32.67±8.09, 59.54±7.96 and 64.06±4.67 kg, and 21.70±2.24, 22.41±3.64, 17.37±4.05, 24.5±0.5 and 27.47±6.85 kg. Irrespective of genotypes, the mean age at puberty, lactation length, litter size, kidding interval and days open were found 167.50±3.49 days, 76.61±4.90 days, 1.71±0.10, 224.44±5.56 days and 52.64 ± 2.30 days, respectively. However, none of the aforementioned traits differed significantly ($P>0.05$) among the five different exotic genotypes. In conclusion, this study provides some basic information on the performances of exotic goat breeds or their crossbreeds at Metropolitan areas under intensive management conditions which could be utilized for designing proper breeding plan in their conservation and simultaneous improvement.

Keywords: morphology, morphometry, production, exotic goat, Rajshahi

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Introduction

Goats are multifunctional animals and play a significant role in the economy and nutrition for landless, small and marginal farmers in most of the developing countries including Bangladesh (Khan *et al.*, 2006). Goat contributes to livestock industry in terms of meat, skin and milk through utilizing available shrubs, tree leaves and vegetation in the road side and fellow lands. The goat population in Bangladesh is about 25.93 million (DLS, 2017). Although Black Bengal alone constituted more than 90% of goats in the caprine population of Bangladesh around 22 years back (Husain *et al.*, 1998) but the figure has been changing with gradual declination of Black Bengal goats. Among the ruminant species in Bangladesh, goat occupies second position next to cattle as an important animal genetic resource and is distributed throughout the country. Irrespective of religion, creed and caste, goat meat (chevon) is very popular for its taste,

flavor, tenderness and juiciness (Mia *et al.*, 1996; Amin *et al.*, 2001). Goat rearing is a small and medium enterprise, which has been practiced largely by landless and marginal farmers in rural areas but it also popular in metropolitan areas particularly for exotic breeds and their crossbreeds.

Rearing of exotic pure and crossbred goats has been a long tradition in Rajshahi metropolitan areas under intensive management practices. The illegal entry of breeding bucks and kids from West Bengal of India to Rajshahi and some other region of Bangladesh contributed to the increase of exotic breeds and their crosses in Bangladesh. On the other hand, the acute shortage of genetically superior Black Bengal buck throughout Rajshahi region is one of the major causes of gradual declination of Black Bengal goat population (personal communication). Pure exotic breeds and crossbred goats in Rajshahi region were found 64.20% (Salina, 2010). Among them, the percentages of Jamunapari, Beetal, Sirohi and

other crosses were 11.33, 26.80, 9.79 and 16.28%, respectively. Notably, 68.15% goat farmers of Rajshahi region rear goats under intensive management system (Salina, 2010). In addition, producer's preference of rearing exotic germplasm in these areas primarily associated with socio-economic factors is also a significant determinant of genetic erosion for Black Bengal goat. However, information is scanty regarding the performances of exotic breeds and the resultant crossbreds under agro-climatic conditions of Rajshahi metropolitan areas. Besides, the scientific documentation is essential component for genetic characterization and breed performance comparison. It is also needed for establishment of profit loss equation under intensive goat production system in that particular area.

According to FAO (2008), phenotypic characterization of animal genetic resources (AnGR) is the first and foremost prerequisite to identify distinct breeds or populations. This is also essential for describing their external features that facilitates their production characteristics in a defined production system (Salako, 2002). The information acquired by characterization studies is necessary for planning the management of AnGR at local, national, regional and global levels (Rege *et al.*, 2003). Although we have substantial information on Black Bengal goat (Husain *et al.*, 1998; Amin *et al.*, 2001; Chowdhury *et al.*, 2002), but information is very limited regarding the performances of exotic goat breeds and their crosses under the prevailing conditions of Bangladesh. Hence, it is required to describe the phenotypic characteristics and production potentials of exotic goat breeds and their crossbreds available in metropolitan areas of Rajshahi before designing any breeding plan and conservation strategy. Considering the above facts and status, the current study was designed to investigate morphology, morphometric features, growth, productive and reproductive performance of available exotic goats and their different types of crosses in Rajshahi metropolitan area.

Materials and Methods

Description of the study area

The present study was conducted at Boalia, Shahmokhdum, Rajpara and Matihar Thana under Rajshahi metropolitan city. It is located at Latitude of 724°22'26"N and Longitude of 88°36'04"E. The duration of the study was from November 2018 to April 2019.

Experimental animals and traits considered

The initial information along with their pictorial view of the exotic goat breeds was acquainted from the FAO Animal Health and Production (Acharya, 1982). Finally, the genotypes of exotic goat were ascertained through phenotypic observation, pedigree analysis as well as interviewing with goat owner. Morphological traits such as coat color, facial profile, ear position, horn and its orientation and hair type were documented using a semi-structured questionnaire along with visual appraisal. The morphometric traits like body length, wither height, head length, ear length, birth weight and mature body weight were envisaged in this study and measured accordingly. The investigated production and reproduction traits were age at puberty (day), milk yield/day, lactation length (day), kidding interval (day), litter size (no.) and days open (day). Information was also recorded on the availability of buck, genotype of bucks and breeding practiced, available feed ingredients, feeding practices as well as other management practices in the goat population studied.

Data collection

A structured questionnaire was carefully designed, pretested and revised accordingly as per objectives of the study. A total of 73 questionnaires were used to collect information from 39 goat flock owners those who had exotic goat breeds or their crosses. Data were collected through interviewing farmers, visual observation and on-spot measurement of the animals using measuring tape and digital weighing balance at farmer's premises.

Data analyses

The data collected from the investigation were recorded in Microsoft excel sheets and carefully reviewed to detect any unusual or extreme values recorded. Descriptive statistics such as mean, range, frequency and percentage were calculated using Microsoft excel. In addition, data were analyzed using Statistical Analysis System (SAS, version 9.1.3) to calculate least square means along with other descriptive statistics. Mean separation was performed using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Distribution of goat genotypes

There were five different exotic goat breeds or crossbreds identified in the studied areas and their distribution are presented in Table 1. The available goat genotypes were Beetal, Sirohi, Jamunapari, Kalahari, Anglo Nubian and Black

Bengal goat and their crosses. The breed's name mentioned in the crossbreds is predominating breed. It is very difficult to identify exact breed composition of the crossbreds. However, Black Bengal is the commonest dam partner of the parents of the crosses. The genotype frequencies of these studied populations were found to be 50.68, 13.70, 8.22, 15.07, 8.22 and 4.11%, respectively. Irrespective of age, Beetal/Beetal crossbred had 32.43% male and 67.58% female. In case of Sirohi/Sirohi crossbred, the ratio of male and female was 50:50. Jamunapari/Jamunapari crossbred had mostly females (83.33%) along with a small proportion of males (16.67%). In Kalahari/Kalahari Crossbred, the numbers of males (66.67%) were higher than the females (33.33%). Anglo Nubian/Anglo Nubian crossbred had 33.33% male and 66.67% female individual. In addition, goats of different age group belong to the respective genotype were shown in Table 1. Among the genotypes, 33 to 67% were doe and 17 to 50% were breeding buck. The proportion of kids was found very low (8.21%) in the surveyed areas due to poor reproductive efficiency of exotic does along with high demand of post-weaning kids by the interested goat keepers. In Rajshahi Metropolitan areas, we found predominantly higher proportion of exotic goat breeds and their crossbreds (more than 96%) where less than 4% Black Bengal goats were identified in the studied

areas. The present findings supported the results of Salina et al. (2010) who reported exotic breeds or crossbreds of Indian origin were predominantly higher in the Rajshahi city areas compared to other parts of Bangladesh. However, the present findings contradicted with the previous studies of Mia et al. (1996); Amin et al. (2001) and Chowdhury et al. (2002) who reported more than 90% of goat population in Bangladesh comprised the Black Bengal while the remainder being Jamunapari and their crossbreds. Notably, this is a unique scenario compared to other areas of Bangladesh. This might be due to the long tradition of the farmers for exotic goat rearing in the studied areas. In addition, farmers' individual choice, availability of exotic goat bucks and does mainly from the neighboring country are also contributing factors for their higher concentration. Strategic location of Rajshahi Metropolitan area which is very close to west Bengal of India, development of urban goataries, availability of exotic breeding buck at the doorstep of the farmers and market demand of the crossbred large sized yearling wethers during festivals perhaps motivated goat keepers to rear aforementioned crossbreds. Above all, crossbreds might be more cost-effective than pure Black Bengal goat which could be the strongest reason for the on-going breed substitution process in that particular area.

Table 1: Genotypic proportion (%) for type and sex of goat in Rajshahi metropolitan area

Genotype	Sex		Type of goat				Genotype Freq. (%)	
	Male	Female	Doe	Buck	Castrated goat	Nanny goat		Kid
Beetal/ Beetal Crossbred (37)	32.43 (12)	67.57 (25)	48.65 (18)	18.92 (7)	10.81 (4)	8.1 (3)	13.51 (5)	50.68
Sirohi/ Sirohi Crossbred (10)	50 (5)	50 (5)	50 (5)	20 (2)	30 (3)	-	-	13.70
Jamunapari/ Jamunapari Crossbred (6)	16.67 (1)	83.33 (5)	50 (3)	16.67 (1)	-	16.67 (1)	16.67 (1)	8.22
Kalahari/ Kalahari Crossbred (11)	66.67 (6)	33.33 (5)	33.33 (5)	50 (4)	16.67 (2)	-	-	15.07
Anglo Nubian/Anglo Nubian Crossbred (6)	33.33 (2)	66.67 (4)	66.67 (4)	33.33 (2)	-	-	-	8.22
Black Bengal (3)	33.33 (1)	66.67 (2)	33.33 (1)	-	33.33 (1)	33.33 (1)	-	4.11
Total (73)	26	47	35	16	9	7	6	100.00

*Values in the parentheses represent the number of observations in the respective category of goat.

Exotic goat genotypes in Rajshahi metropolitan areas

Table 2: Coat color distribution of available exotic goat in Rajshahi metropolitan area

Genotype	Coat color	Observation number	Frequency (%)
Beetal/ Beetal Crossbred	Black	22	59.46
	Black and white	9	24.32
	Black and brown	4	10.81
	Gray and white	2	5.41
Sirohi/ Sirohi Crossbred	White spotted on brown coat color	5	50.00
	White spotted on black coat color	4	40.00
	Brown spotted on Black coat Color	1	10.00
Jamunapari/ Jamunapari Crossbred	White and brown	3	50.00
	White	3	50.00
Kalahari/ Kalahari Crossbred	Tan Color	9	83.33
	Tan and Black	2	16.67
Anglo Nubian/ Anglo Nubian Crossbred	Brown	1	16.67
	Brown and White	3	50.00
	Brown and Black	1	16.67
	White and Red	1	16.67
Black Bengal Goat	Black	3	100.00

Table 3: Mature live weight (kg) and wither height (cm) of exotic pure and crossbred goats in Rajshahi metropolitan area

Genotype	Trait*	Male			Female		
		Min	Max	Mean \pm SE	Min	Max	Mean \pm SE
Beetal/Beetal Crossbred	LW	42.00	84.84	46.88 \pm 5.66 (12)	20.00	39.55	21.7 \pm 2.24 (25)
	WH	33.02	96.52	72.60 \pm 4.39 (12)	30.48	71.12	55.46 \pm 2.67 (25)
Sirohi/Sirohi Crossbred	LW	39.31	83.14	56.07 \pm 8.03 (5)	10.91	30.58	22.41 \pm 3.64 (5)
	WH	68.58	96.52	79.25 \pm 5.04 (5)	45.72	60.96	55.88 \pm 3.21 (5)
Jamunapari/ Jamunapari Crossbred	LW	24.58	40.77	32.67 \pm 8.09 (2)	8.75	26.51	17.37 \pm 4.05 (4)
	WH	60.96	71.12	66.04 \pm 5.08 (2)	40.64	60.96	50.80 \pm 4.28 (4)
Kalahari/Kalahari Crossbred	LW	49.50	82.96	59.54 \pm 7.96 (5)	20.94	29.69	24.5 \pm 0.50 (6)
	WH	76.20	91.44	81.28 \pm 3.59 (5)	60.96	63.5	62.23 \pm 1.27 (6)
Anglo Nubian/ Anglo Nubian Crossbred	LW	59.39	68.73	64.06 \pm 4.67 (2)	10.91	43.44	27.47 \pm 6.85 (4)
	WH	81.28	88.9	85.09 \pm 3.81 (2)	45.72	71.12	60.96 \pm 5.39 (4)

*LW, Mature live weight; WH, Wither height. Values in the parentheses represent the number of observations in the respective category of goat.

Morphology of exotic goats and their crossbreds

The observed coat colors and combinations thereof in the present investigation are shown in the Table 2. Beetal/Beetal crossbred had four different coat colors such as black (59.46%), black and white (24.32%), black and brown (10.81%), and grey and white (5.41%). Three different coat colors were identified in Sirohi/Sirohi crossbred goat as white spotted on brown coat color (50%), white spotted on black coat color (40%) and brown spotted on black coat color (10%). Two distinct coat colors were observed in Jamunapari/Jamunapari crossbreds and Kalahari/Kalahari crossbreds as white with brown (50%) and white (50%), and tan (83.33%) and tan with black (16.67%), respectively. Four different coat colors were identified in Anglo Nubian/Anglo Nubian crossbred goats as solid brown (16.67%), brown with white (50%), brown with black (16.67%) and white with red (16.67%). Normally Beetal has solid black coat color but due to the cross with other breeds, Beetal crossbreds showed various coat color like black and white, black and brown, and grey and white (Doley et al., 2018) and are consistent with the present findings. Bilaspuri and Singh (1993) reported that Beetal had only solid black coat color and is agreed partially to the present study. On the other hand, Waiz et al. (2018) conducted a survey on Sirohi goat breeds and found two different coat colors as white spotted on black coat color and brown spotted on black coat color and is agreed partially with this study. The white spotted on brown coat color observed in this study was absent in the report of Waiz et al. (2018) that might be due to cross with other breeds in the studied areas. Hassan et al. (2010) stated that Jamunapari/Jamunapari crossbred showed normally white

coat color with their long pendulous ear and convex nasal bone and is consistent with the present findings. In another investigation, Jordan (2019) reported that South African Kalahari red goats had tan coat color and is consistent with the present study. A small proportion of Kalahari goat had tan with black coat color that might be due to the results of crossbreeding with other breeds. In the present study, there were four different coat colors were found in Anglo Nubian/Anglo Nubian crossbreds and is supported by the present findings of (Porter et al., 2016) who reported North American Anglo Nubian had white spotted on brown coat color with black border. In general, coat color is a breed specific trait. However, the deviation observed in coat colors due to admixture with various genotypes might alter coat color or color combinations in the investigated samples. In the studied areas, these exotic breeds and their crossbreds showed convex nasal bone with pendulous long ear and are agreed with the previous findings of Salina et al. (2010). Previous studies also reported predominantly convex facial appearance and parrot shape nasal bone in Beetal and Sirohi goat breeds (Bilaspuri and Singh, 1993; Nazeer et al., 2018) and support the present findings.

Morphometry of exotic goats and their crossbreds

The morphometric features like mature live weight, wither height, body length and ear length among the studied goat populations are shown in Table 3 and Table 4. The average live weights of mature buck at the age of 12 to 18 months old were estimated to be 46.88±5.66, 56.07±8.03, 32.67±8.09, 59.54±7.96 and 64.06±4.67kg, respectively for Beetal/Beetal crossbred, Sirohi/Sirohi crossbred, Jamunapari/Jamunapari crossbred, Kalahari/Kalahari crossbred and Anglo Nubian/Anglo Nubian crossbreds.

Table 4: Ear length (cm) of exotic pure and crossbred goats in Rajshahi metropolitan areas

Genotype	Ear length(cm)					
	Male			Female		
	Min	Max	Mean ± SE	Min	Max	Mean ±SE
Beetal/Beetal Crossbred	15.89	40.64	21.48±2.25 (12)	12.08	25.40	16.59±1.19 (25)
Sirohi/Sirohi Crossbred	17.78	30.48	23.37±2.18 (5)	7.62	25.40	17.78±2.89 (5)
Jamunapari/Jamunapari Crossbred	17.78	20.32	19.05±1.27 (2)	7.62	15.24	12.07±1.59 (4)
Kalahari/Kalahari crossbred	20.32	34.29	26.35±2.90 (5)	17.78	25.40	21.59±3.81(6)
Anglo Nubian/Anglo Nubian Crossbred	20.32	40.64	30.48±10.16 (2)	10.16	17.78	15.87±1.90 (4)

Values in the parentheses represent the number of observations in the respective category of goat.

Exotic goat genotypes in Rajshahi metropolitan areas

Table 5: Production and reproduction performances of different exotic pure and their crossbreds available in Rajshahi metropolitan area

Genotype	AP (day)	LL (day)	KI (day)	LS (no.)	DO (day)
Beetal/Beetal Crossbred	170.56±5.74 (18)	80.31±7.42 (15)	225.00±4.00 (9)	1.94±0.33 (18)	47.87±3.00 (15)
Sirohi/Sirohi Crossbred	163.00±5.39 (5)	74.00±7.31 (5)	155.67±50.63 (3)	2.00±0.00 (4)	56.25±3.35 (4)
Jamunapari/ Jamunapari Crossbred	162.50±2.50 (2)	62.50±12.50 (2)	-	2.00±0.00 (2)	59.00±1.00 (2)
Kalahari/ Kalahari Crossbred	160.0±10.00 (4)	82.50±2.50 (4)	225.0±15.00 (4)	2.00±0.00 (4)	-
Anglo Nubian/ Anglo Nubian Crossbred	167.50±7.50 (4)	65.00±11.46 (3)	-	1.50±0.29 (3)	44.76±12.38 (4)
Average	167.50±3.49 (33)	76.61±4.90 (29)	224.44±5.56 (18)	1.71± 0.10 (31)	52.64±2.30 (25)
Level of significance (P value)	0.70	0.703	0.442	0.872	0.857

Values in the parentheses represent the number of observations in the respective category of goat, AP=Age at puberty, LL= Lactation length, KI= Kidding interval, LS=Litter size and DO=Days open

The corresponding live weights of does for the said genotypes at the same age were found to be 21.70±2.24, 22.41±3.64, 17.37±4.05, 24.5±0.50, and 27.47±6.85 kg, respectively (Table 3). The average wither heights of these above stated genotypes found to be 72.60±4.39, 79.25±5.04, 66.04±5.08, 81.28±3.59, and 85.09±3.81 cm, respectively in bucks and that of 55.46±2.67, 55.88±3.21, 50.80±4.28, 62.23±1.27 and 60.96±5.39 cm, respectively in does. Among the investigated genotypes, the average body lengths of mature male varied between 66.04±5.08 and 85.09±3.81 cm and that of 50.8±4.28 and 62.23±1.27 cm, respectively, in adult females. The highest ear length of mature buck was observed in Anglo Nubian/Anglo Nubian crossbred (30.48±10.16 cm) while the lowest was found in Jamunapari/Jamunapari crossbred (19.05±1.27 cm). In mature females, the highest and the lowest ear lengths were observed in Kalahari/Kalahari crossbred (21.59±3.81 cm) and Jamunapari/Jamunapari crossbred (12.07±1.59 cm), respectively. The body weight, heart girth, body length, wither height and ear length of female Beetal goat were 28.00 kg and 30.00, 26.50, 26.50, and 6.00 inch, respectively as reported by Bilaspuri and Singh (1993) and is

comparable with the present findings. However, admixtures with more than two different genotypes might be responsible for the changes compared to present values. Chinnamani *et al.* (2018) found mature body weights of Sirohi purebred male and female at 12 months of age to be 50.37±2.52 and 22.54±0.17 kg, respectively and is almost similar with the present findings. Hassan *et al.* (2010) reported that mature male and female body weights at 12 months of age were 56.56±2.05 and 25.55±2.74kg, respectively for Jamunapari breed which is higher than the present study. Admix with Black Bengal or other exotic goat populations as well as haphazard breeding in a small flock might be responsible for the reduced performances in the studied Jamunapari goat population. Doley *et al.* (2018) studied that the mean growth performances of Crossbred female Beetal goats in terms of body weight at 12 months age was 22.07±0.13 kg and is consistent with the present findings. Jordan (2019) stated that mature male and female body weights of Kalahari goats at 12 months of age were 70 and 45 kg, respectively and is quite higher compared to present findings. This variation may be associated with genetic make-up and feeding management between animals of previous and present studies. In another study,

Porter *et al.* (2016) reported that average body weight of adult male Anglo Nubian goat was 140 kg whereas the female average body weight was 110 kg and is greatly higher than the present study. This variation in mature live weight compared to present results might be attributed by sample size, breed, genetic admixture, unidentified environmental factors, plane of nutrition or breeding in a closed flock.

Production and reproduction performances

The average productive and reproductive performances of exotic goat breeds and their crosses are presented in Table 5. The average age at puberty, lactation length, litter size, kidding interval and days open of different exotic breeds and their crossbreds were 167.50±3.49 days, 76.61±4.90 days, 1.71±0.10 no., 224.44±5.56 days and 52.64 ± 2.30 days, respectively. More particularly, the average age at first puberty of Beetal/Beetal crossbred, Sirohi/Sirohi crossbred, Jamunapari/Jamunapari crossbred, Kalahari/Kalahari crossbred and Anglo Nubian/Anglo Nubian crossbred does were found 170.56±5.74, 163.00±5.39, 162.50±2.50, 160.00±10.00 and 167.50±7.50 days, respectively. The average lactation length and litter size of these corresponding genotypes were 80.31±7.42, 74.00±7.31, 62.50±12.50, 82.50±2.50 and 65.00±11.46 days, and that of 1.94±0.33, 2.00±0.00, 2.00±0.00, 2.00±0.00 and 1.50±0.29, respectively. The average kidding interval of Beetal/Beetal crossbred, Sirohi/Sirohi crossbred and Kalahari/Kalahari crossbred were found 225.00±4.00, 155.67±50.63 and 225.00±15.00 days, respectively. However, none of the traits differed significantly among the breeds or breed crosses ($P>0.05$) (Table 5). Hassan *et al.* (2010) reported that average age at first puberty, lactation length and days open in Jamunapari/Jamunapari crossbred was 180.06±1.75, 82.50±8.50, 96.00±2.50 days, respectively and supports the present findings. Bilaspuri and Singh (1993) reported the age at puberty, lactation length, kidding interval and days open in Beetal goat breed to be 220.56±5.74, 110.31±5.25, 255±4.00 and 79.66±1.30 days, respectively and is higher than this study. In another study, Yadav *et al.* (2017) observed that the mean of age at first conception, age at first kidding, service period, dry period, kidding interval and days open in Sirohi goats were 546.41±9.13, 698.31±9.10, 206.23±3.26, 197.64±3.18, 356.21±0.32 and 95.16±0.07 days, respectively and is significantly higher than the current study. In another study, Waiz *et al.* (2018) reported that the mean age at first conception, age at first kidding, weight at

first conception and weight at first kidding in Sirohi goats were 244.18 ± 13.05, 394.88 ±13.05 days and 26.77±0.21, 30.90±0.18, kg respectively. Breed or genotype, small sample size with large variability, quality and quantity of feed, management system and order of parity might be the major attributing factors for differences between present and previous findings. Moreover, pooled sampling was performed from pure and crossbred individuals in a particular breed that also responsible for deviations between the present and previous results. It is notable to mention that there is no or limited information available regarding the performances of exotic pure or crossbred goat in Bangladesh for making comparison with the present study. Taken together, this study provides some preliminary information on productive and reproductive potentials of available exotic goat genotypes.

Conclusion

The results of the present study revealed the numerical predominance of exotic goat breeds and their crosses in Rajshahi metropolitan areas. More particularly, Beetal and Beetal crossbreds comprised half of the total population in the studied areas. The morphological and morphometric variations were diverse within and among the studied goat populations due to indiscriminate breeding. All of those exotic breeds and crossbreds had almost equal productive and reproductive performance under intensive management system. In conclusion, the information generated from this study could be utilized for evaluating the potentials of transboundary exotic goats and their crosses in the concerned agro-climatic zone and socio-economic context. Moreover, findings of this study may provide hints to the policy makers for conservation as well as development of Black Bengal goat as this valued indigenous goat genetic resource has fallen under the threat of breed substitution.

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Conflict of interest

There is no conflict of interest among the authors.

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