



Morphometry and performance of Black Bengal goats at the rural community level in Bangladesh

MP Choudhury¹, SC Sarker¹, F Islam¹, A Ali¹, AKFH Bhuiyan¹, MNM Ibrahim², AM Okeyo²

¹Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh; ²International Livestock Research Institute (ILRI), Nairobi, Kenya

Abstract

Data on morphometrics and performance of 106 Black Bengal goats were collected through an in-depth monitoring survey conducted in 73 families of Gangatia, Borachala and Pachpai villages of Bhaluka Upazila, Mymensingh, Bangladesh using a structured questionnaire. Analyses of variance were performed using the General Linear Model (GLM) procedure under Statistical Package for the Social Sciences (SPSS) version 14.0. Differences between mean values were separated using Duncan's Multiple Range Test (DMRT). Body weight of goats significantly ($p < 0.001$) differed with age classes and body condition scores. Average body weight of Black Bengal goat was 14.47 ± 0.48 kg. Body length at was 46.01 ± 0.66 cm. Chest girth significantly ($p < 0.001$) differed with age classes and body condition scores. Average chest girth of Black Bengal goat was 56.10 ± 0.60 cm. Withers height significantly ($p < 0.001$) differed with age classes and body size. Average withers height of Black Bengal goat was 46.41 ± 0.36 cm. Scrotal length and scrotal circumference did not significantly ($p > 0.05$) differ with age classes, villages and body condition. The number of services needed for each conception of Solid Black, Toggenburg pattern and Brown Bezoar goats were 1.32 ± 0.31 , 1.08 ± 0.22 , 1.25 ± 0.31 , 1.01 ± 0.26 and 1.23 ± 0.27 , respectively. The lowest kidding interval was observed in Borachala village (169.80 ± 38.11 days) and in Solid Black goats (176.71 ± 36.17 days). The highest litter size was found in does (1.68 ± 0.39) of Gangatia village (1.67 ± 0.51) and in Solid Black goats (1.67 ± 0.54). The lowest abortion rate was found in Solid Black goats (6.14%). The lowest kid mortality was observed in Solid Black goats (10.00%). Variation observed in morphometric and production traits of indigenous Black Bengal goats indicated an opportunity for their improvement through an *in-situ* pure breeding program.

Key words: Black Bengal goat, coat color, morphometry, reproductive performance.

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Introduction

Goats play an important role in livelihoods of smallholder farmers in Bangladesh as they serve as assets that can be easily liquidated to provide cash in times of need Akhter et al. (2006). Bangladesh has the second highest population of goat among the Asiatic countries which accounts for about 60.60 million heads representing 57% of total ruminant livestock and more than 90% of the goats of the country are of the Black Bengal breed Husain (1993); Amin et al. (2001). Black Bengal goats are dwarf goats and are known to be famous for its adaptability, higher disease resistant, fertility, fecundity, early sexual maturity, larger litter size, delicacy of meat and superior skin quality Islam (2001); Devendra and Burns (1983); Hussain et al. (1998). Though majorities of the Black Bengal bear black coat color, black and white, brown, brown and white and white coat color colors are also common in the Black Bengal population. They are more or less evenly distributed throughout the country

with a relatively higher concentration in the northwestern area of Bangladesh. It is also found throughout the eastern and north eastern India. Goats are deeply embedded in almost all over Bangladeshi culture and are considered as true friends to the rural poor. The old saying that "the goat is the poor man's cow" still holds true in the majority of developing countries. Goats play a unique role in supporting some of the poorest people in Bangladesh and can play a powerful role in lifting them out of poverty towards prosperity Amin (2000). Goat rearing is considered as one of the main means of survival for many women in remote villages. More importantly, above 98% of Black Bengal goats are being managed in the traditional village system of the country (Husain et al.1998) where mature and quality breeding bucks are not available. Government or private breeding service is not available in the rural villages too. Goat raising community therefore can organize among them self to produce breeding bucks for their use. There are no previous research attempts in this regard in Bangladesh

*Corresponding Author: cpanir@yahoo.com

Husain (2004). So, it is worth testing the research model for improving Black Bengal goats in Bangladesh through community managed breeding flock. Therefore, the present study was undertaken to investigate the morphometry and performance of Black Bengal goats at community level.

Materials and Methods

The experiment was conducted at rural community level goat flocks of Gangatia, Borachala and Pachpai villages under Bhaluka Upazila of Mymensingh district of Bangladesh. Bhaluka is located at 24.3750°N; 90.3778°E 24.3750; 90.3778. The ecology of three villages of Bhaluka is more or less same. The temperature ranges from 12^oC to 33^o C, and the annual rainfall averages 2147 mm. Data from a total of 106 goats measured in 73 households under the community based goat flocks were included in this study. The farmers were selected randomly using the UNEP-GEF-ILRI FAnGR Asia Project developed baseline survey questionnaire at the said three different villages.

Age classes of goats were: Kids = birth to weaning, Yearling = weaning to 11 months, Replacement females = 12 to 18 months, Bucks=adult males > 12 months and Does=adult females > 18 months. According to coat color variation, goats were categorized into: i) Solid Black locally called deshi chaagol, ii) Toggenburg pattern locally called boiragi chaagol, iii) Brown Bezoar locally called Shiyaila chaagol, iv) Dutch belt, v) Silver Bezoar and vi) different other combinations. Different coat colors of goats are shown in the Figure 1. Body weight of the individual goat was taken from all age classes. Animals were weighed using weighing scale. Body weight was recorded in kg. Body condition of goats was recorded according to the farmer's and enumerator's observation. The following body measurements were considered for morphometric study of Black Bengal goats. Body length, chest-girth, wither height, scrotal length and scrotal circumference. Different body measurements, scrotal length and scrotal circumference were taken by a measuring tape in centimeter (cm).

The recorded reproductive traits at community level flocks were number of services per conception, litter size, kidding interval, abortion rate, mortality rate of kids and type of breeding practices.



Figure 1. Different coat colors of Black Bengal goat (Source: Nozawa et al. 1984; Faruque and Khandoker 2007)

All the data obtained from the three villages covering all the community goats were organized, structured and analysis of variance were performed using the General Linear Model (GLM) procedure under Statistical Package for the Social Sciences (SPSS) version 14.0. In addition, for significant variables, means were separated using Duncan's Multiple Range Test (DMRT).

The following general linear statistical models were used.

Model a:

$$Y_{ijklmn} = \mu + A_i + V_j + B_k + H_l + C_m + e_{ijklmn}$$

where,

Y_{ijkl} is the dependent variable (body weight, body length, chest girth and wither height) of the

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experiment; μ is the overall mean; A_i is the effect of the i^{th} age class; V_j is the effect of the j^{th} village; B_k is the effect of the k^{th} body condition; H_l is the effect of the l^{th} horn pattern; C_m is the effect of the m^{th} coat color and e_{ijklmn} is the error term. There were very few observations on mature males and hence the analysis excluded sex as a main effect in the above model.

Model b:

$$Y_{ijklmno} = \mu + A_i + V_j + C_k + T_l + S_m + K_n + L_o + e_{ijklmno}$$

where,

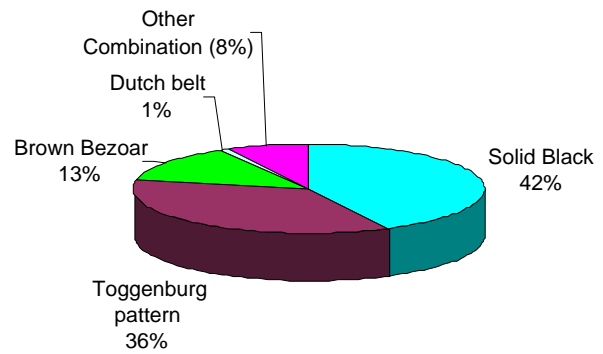
Y_{ijkl} is the dependent variable (service per conception, kidding interval and litter size) of the experiment; μ is the overall mean; A_i is the effect of the i^{th} age class, V_j is the effect of the j^{th} village, C_k is the effect of the k^{th} coat color, T_l is the effect of the l^{th} type of breeding practices, S_m is the effect of the m^{th} service per conception, K_n is the effect of the n^{th} kidding interval, L_o is the effect of the o^{th} litter size and $e_{ijklmno}$ is the error term.

Results

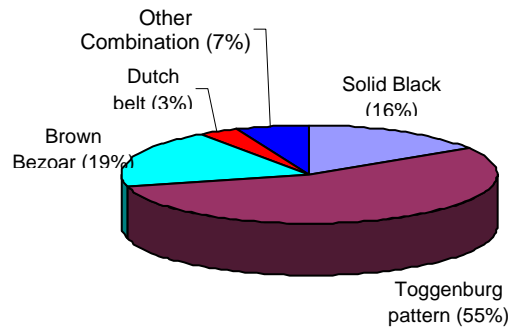
Out of 165 Households, 73 households were found as family goat raiser. About 42.5 % had 1 goat, 31.5 % had 2 goats, 13.7 % had 3 goats, 6.8% had 4 goats, 4.1% had 5 goats, and 1.4% had 8 goats. At three villages, does and bucks of Black Bengal goats appeared at the ratio of 92.45: 7.55. Doe (100%) was highest in Gangatia than that of other villages. Buck (11%) was highest in Pachpai than that of other villages (Figure 4.1: a-d). Solid Black (42%) was highest among others coat color of goats in all the three villages. Percent of Solid Black Bengal (65) was highest in Pachpai than that of other two villages. Toggenburg pattern (55%) was highest in Gangatia than that of other villages. Brown Bezoar was very similar (18-19%) in Gangatia and Borachala but lower in Pachpai. Other combination (14%) was highest in Borachala and lower in Pachpai.

Table 1. Distribution of percentage of goats according to sex in each village

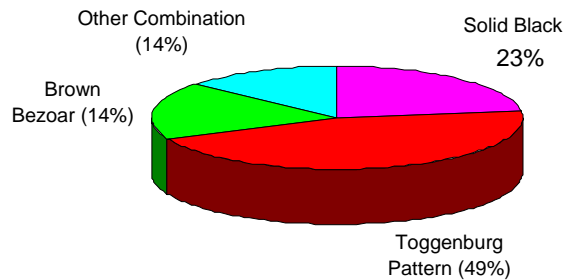
Sex	Gangatia	Borachala	Pachpai	Total
Male	0	9	11	8
Female	100	91	89	92



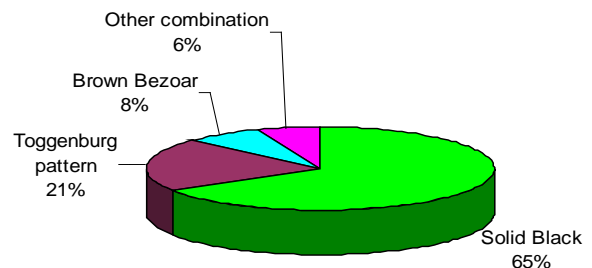
a) Coat color distribution of goat in all villages



b) Coat color distribution of goat in Gangatia



c) Coat color distribution of goat in Borachala



d) Coat color distribution of goat in Pachpai

Figure 4. Coat color distribution pattern in different villages (a-d)

Table 1 shows the effect of different factors on body weight of goats. The effects of age class and body condition were highly significant ($p < 0.001$), while no significant effects ($p > 0.05$) were found for the village, horn pattern and coat color. Minimum and maximum body weight of Black Bengal goats in this study were 6.50 and 28.00 kg. The average body weight of Black Bengal goat was 14.47 ± 0.48 kg. Table 1 also shows the effect of different factors on body length on goats. The effect of age class was significant ($p < 0.001$) on body length of goats while no significant effect ($p > 0.05$) was found for village, body condition, horn pattern and coat color. Minimum and maximum body length of Black Bengal goat in this study was found to be 35.00 and 87.00 cm, respectively. The average body length of Black Bengal goat was 46.01 ± 0.66 kg.

It also appeared from Table 1 that effect of age class, village and body condition was significant ($p < 0.001$) on chest girth while no significant effect ($p > 0.05$) was found for horn pattern and coat color. Minimum and maximum body length of

Black Bengal goat in this study was found to be 44.00 and 72.00 cm respectively. The average chest girth of Black Bengal goat was 56.10 ± 0.60 kg. And table 1 shows the effect of different factors on wither height of goats. Analysis of variance shows that effect of age class was significant ($p < 0.001$) on wither height while no significant ($p > 0.05$) results were found for village, body condition, horn pattern and coat color. Minimum and maximum wither height of Black Bengal goat in this study was found to be 39.00 and 56.00 cm, respectively. The average body length of Black Bengal goat was 46.41 ± 0.36 kg.

Reproductive traits

The range of kidding interval, litter size and service per conception of Black Bengal goats were 150-365 days, 1-4 kids, 1-2 kids, respectively. The average kidding interval, litter size and service per conception of Black Bengal goats were 188.55 ± 8.62 days, 1.58 ± 0.09 and 1.10 ± 0.05 , respectively.

Table1: Effect of different factors on body weight, body length, chest girth and wither height

Factor	Category	n	Mean±SE			
			BWT	BL	CG	WH
<i>Level of Significance</i>			***	***	***	***
Age (months)	Yearlings	23	8.79 ^c ±0.87	40.17 ^b ±2.03	49.99 ^c ±1.12	42.69 ^c ±0.94
	Replacement females	19	11.65 ^b ±0.87	43.59 ^b ±2.02	53.13 ^b ±1.11	44.79 ^{bc} ±0.94
	Bucks	4	11.32 ^b ±1.35	42.11 ^b ±3.11	52.48 ^b ±1.73	45.96 ^b ±1.46
	Does	60	15.80 ^a ±0.85	49.04 ^a ±1.94	58.73 ^a ±1.07	48.10 ^a ±0.90
<i>Level of Significance</i>			NS	NS	*	NS
Village	Gangatia	31	11.56 ^b ±0.83	43.70 ^b ±1.92	53.15 ^b ±1.06	45.11±0.89
	Borachala	22	12.46 ^a ±0.91	42.46 ^a ±2.12	54.83 ^a ±1.17	46.08±0.98
	Pachpai	53	11.65 ^b ±0.82	45.01 ^a ±1.92	52.77 ^{ab} ±1.06	44.96±0.89
<i>Level of Significance</i>			**	NS	**	NS
Body condition	Very thin	2	9.67 ^c ±1.7	42.95±3.98	53.22 ^b ±2.18	45.56±1.84
	Thin	59	12.24 ^b ±0.64	43.02±1.54	52.75 ^b ±0.82	45.25±0.69
	Good	45	13.75 ^a ±0.66	45.21±1.54	54.77 ^a ±0.85	45.28±0.71
<i>Level of Significance</i>			NS	NS	NS	NS
Horn pattern	Horned	92	11.66±0.76	43.56±1.78	53.83±0.98	45.98±0.85
	Polled	14	12.11±0.93	43.89±2.15	53.34±1.19	44.78±1.00
<i>Level of Significance</i>			NS	NS	NS	NS
Coat color	Solid Black	45	12.89±0.79	43.36±1.84	54.88±1.01	45.73±0.85
	Toggenburg pattern	38	13.50±0.76	43.98±1.76	55.20±0.97	45.73±0.81
	Brown Bezoar	14	12.97±0.86	44.37±2.01	55.20±1.10	44.66±0.93
	Dutch belt	2	8.0±2.41	43.17±5.60	49.27±3.08	45.60±2.53
	Other combination	7	12.07±0.94	43.77±2.18	53.43±1.20	44.10±1.00
Range		106	6.50-28.00	35.00-87.00	44.00-72.00	39.00-56.00
Mean		106	14.47±0.48	46.01±0.66	56.01±0.60	46.41±0.36
CV%		106	33.86	14.76	10.93	7.93

Yearlings, weaning to 11 months; Replacement females, 12 to 18 months; Does, >18 months; BWT, body weight; BL, body length; CG, chest girth; WH, wither height; Means with uncommon superscripts differ significantly (as per DMRT); *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$; NS, not significant; n, number of goats

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Table 2: Effect of different factors on reproductive traits in goats

Factor	Category	Mean \pm SE		
		SPC	KI(days)	Litter size
<i>Level of Significance</i>				
Age (months)	Replacement female	1.09 \pm 0.32 (3)	199.45 \pm 41.05 (3)	1.40 \pm 0.56 (3)
	Doe	1.24 \pm 0.23 (28)	189.58 \pm 28.67 (28)	1.68 \pm 0.39 (28)
<i>Level of Significance</i>				
Village	Gangatia	1.09 \pm 0.30 (11)	204.11 \pm 36.17 (11)	1.67 \pm 0.51 (11)
	Borachala	1.32 \pm 0.31 (5)	169.80 \pm 38.11 (5)	1.56 \pm 0.54 (5)
	Pachpai	1.08 \pm 0.22 (15)	209.64 \pm 29.92 (15)	1.39 \pm 0.38 (15)
<i>Level of Significance</i>				
Coat color	Solid Black	1.25 \pm 0.31 (10)	176.71 \pm 36.17 (10)	1.67 \pm 0.54 (10)
	Toggenburg pattern	1.01 \pm 0.26 (13)	226.52 \pm 32.30 (13)	1.56 \pm 0.45(13)
	Brown Bezoar	1.23 \pm 0.27(8)	180.31 \pm 35.04(8)	1.38 \pm 0.48 (8)
<i>Level of Significance</i>				
TBP	Natural control	1.13 \pm 0.16 (29)	212.17 \pm 19.42 (29)	1.29 \pm 0.28 (29)
	Natural uncontrol	1.19 \pm 0.41 (2)	176.85 \pm 53.61 (2)	1.79 \pm 0.71 (2)
<i>Level of Significance</i>				
SPC	1	-	158.93 \pm 29.40 (28)	1.57 \pm 0.10 (28)
	2	-	230.10 \pm 39.26 (3)	1.67 \pm 0.29 (3)
<i>Level of Significance</i>				
KI (days)	150	0.89 \pm 0.34 (3)	-	1.69 \pm 0.58 (3)
	165	0.97 \pm 0.41 (2)	-	1.13 \pm 0.71 (2)
	180	1.11 \pm 0.21 (24)	-	1.75 \pm 0.36 (24)
	365	1.68 \pm 0.34 (2)	-	1.60 \pm 0.60 (2)
<i>Level of Significance</i>				
Litter size	1	1.14 \pm 0.26 (13)	197.98 \pm 34.39 (13)	-
	2 ⁺	1.18 \pm 0.41 (18)	191.05 \pm 31.49 (18)	-
Range		1-2	150-365	1-2 ⁺
Overall mean \pm SE		1.10 \pm 0.05 (31)	188.55 \pm 8.82 (31)	1.58 \pm 0.09 (31)
CV%		27.27	25.45	31.65

SPC, service per conception; KI, kidding interval; TBP, type of breeding practices; Replacement females, 12 to 18 months, Does, >18 months; *, $p < 0.05$; NS, non significant; Figures in the parenthesis indicate the number of observation

Numbers of service per conception were 1.09 \pm 0.32 and 1.24 \pm 0.23 for replacement females and does. Numbers of service per conception varied from 1.08 \pm 0.22 (Pachpai) to 1.32 \pm 0.31 (Borachala). Coat color and service per conception had significant ($p < 0.05$) effect on kidding interval. Kidding interval was shorter among Solid black goats (176.71 \pm 36.17 days) compared to those with Toggenburg color patterned goats (226.52 \pm 32.30 d) and Brown goats (180.31 \pm 35.04 d). Age, village, coat color, type of breeding practices, service per conception and kidding interval had no effect ($p > 0.05$) on litter size of goats. Litter size was higher in does (1.68 \pm 0.39) than replacement females (1.40 \pm 0.56). Litter size was higher in solid Black (1.67 \pm 0.54) among other two coat color goats Toggenburg (1.56 \pm 0.45) and Brown (1.38 \pm 0.48)

Discussion

Katsumata et al. (1984) found that the average body weight of Black Bengal goat was 15.00 kg

which is almost similar to the present study. Tesfaye (2009) found a body weight of 12.73 \pm 0.13 kg in indigenous goats in Ethiopia which is almost similar to the body weight of replacement females and bucks. Paul (2008) reported the body weight of bucks and does at 12 months of age as 14.20 \pm 0.20 and 12.40 \pm 0.41 kg respectively which are higher than the body weight of bucks and replacements females observed in the present study. Mamabolo et al. (2010) observed the body length of goats in South Africa as 56 to 98 cm at village level which is higher than that obtained in the present study. Paul (2008) reported the body lengths of Black Bengal Bucks and does as 46.50 \pm 0.77 and 42.15 \pm 0.55 cm, respectively which is closer to the body weight of replacement females found in this present study. Katsumata et al. (1984) observed an average body length for does of 46.6 \pm 0.3 cm which strongly agrees with the results obtained in the present study. Mamabolo et al. (2010) reported the wither height of goats in South Africa was 51 to 75 cm at village level

which is higher from the present study. Mamabolo et al. (2010) reported the wither height of goats in South Africa as 51 to 75 cm at village level which was higher from the present study. Paul (2008) found the wither height of Black Bengal bucks and does at 12 months of age as 46.90 ± 0.33 and 43.10 ± 0.74 cm respectively which strongly agrees with the results of wither height of bucks and replacement females obtained in this present study though the wither height of does was higher in the present study.

Ahmed (2006) observed the average kidding interval, litter size and service per conception of Black Bengal Goats were 193 ± 9.80 d, 1.94 ± 0.56 and 1.5 ± 0.69 , respectively which strongly support the present study. Mamabolo et al. (2010) reported average kidding interval of goats in South Africa at village level was 145-148 d which is shorter from the present study. Mamabolo et al. (2010) reported average litter size of goats in South Africa at village level as 1.5 which is almost similar to the present study. Body weight, body length, chest girth and wither height of adult females were higher than other age groups. Litter size was higher in solid black goats. Less service was required for replacement females.

Results obtained from this study were based on the field survey taking rural community goat raisers' opinion, direct measurement and weighing of animals. It was revealed that variation in age, coat color and location had a great effect on the morphometry and production of Black Bengal goats. Results indicate that body weight, body length, chest girth and wither height of adult females was higher than other age groups. It was also observed that Toggenburg coat colour patterned goats were heavier than other coat color goats. Replacement females were found to be superior to doe in service per conception while they were inferior in kidding interval. Goats of Gangatia were found to be superior to goats of Borachala in litter size and while they were inferior in service per conception and kidding interval. Goats of Pachpai village were found to be superior to goats of Gangatia in service per conception while they were inferior in kidding interval and litter size. Solid Black goats were found to be superior to Toggenburg pattern and Brown Bezoar goats in kidding interval and litter size while they were inferior to service per conception. Abortion rate was lower in Solid Black than Toggenburg pattern and Brown Bezoar. Kid mortality was found to be lower in Solid Black

goats than Toggenburg pattern and Brown Bezoar.

Conclusion

The body weight, body length, chest girth and wither height of adult females were higher than other age groups. Variation in age, coat color and location had a great effect on the morphometry and production of Black Bengal goats. Results thereby indicated an opportunity for improvement of rural Black Bengal goats through a pure breeding program.

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