



## Impact of community based breeding program on breeding buck availability, growth and reproductive performance of Black Bengal goat

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### Abstract

The present study was undertaken to evaluate the availability of breeding bucks as well as growth and reproductive performances of Black Bengal goat under community based breeding program. A total of 30 goat rearers in three areas of Sakhipur upazilla were selected based on the survey result. Selected goat rearers were trained on scientific rearing, management and community-based breeding of Black Bengal goat and also build up community link with them. Three Black Bengal breeding bucks have been distributed among three potential farmers in three villages under Sakhipur upazilla. The management and performance of Black Bengal goats were monitored closely and analyze the impact of community based breeding program. The analysis of the growth performance showed that male kids attained significantly ( $p < 0.05$ ) higher birth weight ( $1.28 \pm 0.04$  kg) than that of female kids ( $1.06 \pm 0.02$  kg). The body weights of male at 3, 6, 9 and 12-month were  $5.41 \pm 0.28$ ,  $9.18 \pm 0.32$ ,  $12.87 \pm 0.35$  and  $16.91 \pm 0.46$  kg whereas female reached significantly ( $p < 0.05$ ) lower body weight as  $4.97 \pm 0.16$ ,  $8.02 \pm 0.21$ ,  $10.91 \pm 0.23$  and  $14.21 \pm 0.34$  kg at the same ages, respectively. Average daily body weight gain up to 12 months of age was also significantly ( $p < 0.05$ ) higher in males ( $43.42 \pm 1.17$  g/day) than females ( $36.53 \pm 2.49$  g/day). On the other hand, season had a significant effect ( $p < 0.05$ ) on the body weights of Black Bengal goat at 0 (birth), 3, 6, 9, 12-month of age. In case of reproductive performances, it was revealed that age at sexual maturity was  $199.32 \pm 2.41$  days; age at first kidding  $393.23 \pm 1.38$  days; service per conception  $1.17 \pm 0.04$ , and litter size was  $1.76 \pm 0.08$  in community based breeding program. Beside these, post-partum heat period of Black Bengal goat was found  $47.50 \pm 0.87$  days. Comparing with the findings of previous research works, these results suggested that community based breeding program has not only reduced the scarcity of good quality breeding bucks but also improved the growth and reproductive performances of Black Bengal goats.

**Keywords:** breeding program, body weight gain, scarcity, growth rate, Black Bengal

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### Introduction

Goats are economically very important and promising animal genetic resources in the developing countries, especially in Asia and Africa. They have been part of rural livelihoods and have been instrumental in poverty reduction in resource poor areas. The poor people are more likely to own goats than cattle, so support for goat-keeping can be a valuable entry point into poor communities to fight against poverty and hunger. Among the Asiatic countries, Bangladesh has the fourth highest population of goats (FAO, 2010) and presently the goat population in Bangladesh is estimated as 262.67 lakh (DLS, 2019). Bangladesh has only one goat breed which is popularly known as Black Bengal goat. It is estimated that more than 90% of goat population in Bangladesh comprised the Black Bengal goats

(Husain, 1993). It is a dwarf breed and known to be famous for its high adaptability, fertility, prolificacy, delicious meat and superior skin (Devendra and Burn, 1983; Husain *et al.*, 1996). Black Bengal goats have wide variations in color, body size and weights found in different locations. They have different coat color variations that are black, brown, white and any combination of those colors at any proportion (Nozawa *et al.*, 1984). Previous researches also showed that there exist substantial genetic variations among individuals in the production traits of Black Bengal goat, indicating scope for increasing productivity through breeding approaches (Amin, 2014). Husain (1993) also recommended that Black Bengal goat has high potentiality for its further improvement through selective breeding as there exists large within breed variation and there are individuals with

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outstanding performance even under field condition. But acute shortage of Black Bengal breeding bucks is considered as the severe aspect of goat production constraints in the rural areas (Husain *et al.*, 1996). From the baseline survey, it was revealed that more than 70% farmers faced severe shortage of breeding bucks for serving their does and had to depend on natural mating (Khandoker *et al.* 2011). Same buck has been using generation after generation without planning in natural mating. That's why inbreeding depression is seriously observed among the goat population which hindrance the overall production potential of Black Bengal goat. Artificial insemination (AI) is the method of choice of the farmers around the world for the genetic improvement of the livestock (Vishwanath, 2003). But unfortunately, AI has not yet such universal acceptance in the goat breeding industries (Evans and Maxwell, 1987).

In this context, community-based planned breeding program may play an important role for the sustainable genetic improvement of Black Bengal goat. Presently about 98% Black Bengal goats are being reared in the traditional village system of the country (Husain, 1998); therefore, community based breeding program involving farmers' active participation of the community might reduce the scarcity of breeding bucks for serving the does in time and improve the productive and reproductive performance of Black Bengal goat. Other countries like Africa, Ethiopia have also implemented community based breeding program and improved their native genetic resources. A very few research works have been done in Bangladesh based on the community based planned breeding approach and evaluate the performance of Black Bengal goat. From this point of view, the present study was undertaken to evaluate the impact of community based breeding program on growth and reproductive performance of Black Bengal goat.

### **Materials and Methods**

The Present study was conducted at Jadabpur, Hatibandha and Kalia union of Sakhipur upazilla in Tangail district under the Department of Animal Breeding and Genetics, Bangladesh Agricultural University. This research work was conducted in the following ways:

#### **Selection and training of goat rearers**

Initially, a survey was conducted using pre-tested questionnaire to know the socio-economic status of existing goat rearers and their management system. Thereafter, 10 potential goat rearers in each union (a total of 30 goat rearers in three

unions) were selected. Moreover, three farmers in these three unions who showed interest in rearing breeding bucks (male goat) were also selected and registered. Registered goat rearers were trained on scientific rearing, management and community based breeding program. An easy recording system was developed and introduced to record the breeding, productive and reproductive performances of Black Bengal goat. Therefore, a community was formed in each area among the goat rearers.

#### **Rearing breeding bucks in the community**

Superior bucks were selected on the basis of body weight at 6-month of age  $\geq 8$  kg, good body conformation and early age at puberty ( $<180$  days). As superior breeding bucks were collected from known sources, it has got merit in the sense that bucks have some pedigree, apparent growth per record and milking ability of its mother. After selection of superior quality breeding bucks, they were distributed among 3 selected farmers in three areas (Jadabpur, Hatibandha and Kalia). Under the project funding, breeding buck sheds were prepared at the selected farmer's house and feed and other management support were also provided to the farmers. In addition, breeding bucks were fed germinated gram @ 50 g/day in the morning. These registered bucks were then used to serve the does in selected areas rotationally.

#### **Management practices of goat by the community members**

Registered farmers maintained goats in the traditional housing system. All animals were individually tagged for proper recording before starting the research work. The goats were allowed to graze in the naturally available pasture land adjacent to the farmer's house. They were also provided with tree leaves, kitchen waste and leftovers from family meals. Goats were allowed to feed concentrate feed during pregnancy and early lactation. All goats were vaccinated and dewormed routinely. Vaccination against *Peste des petits ruminants* (PPR) was conducted twice in a year. All goats under the community were also dewormed thrice in a year.

#### **Parameters to be recorded**

The productive traits (birth weight, body weight at different ages and average daily body weight gain) were recorded according to Table 1. The reproductive traits such as age at sexual maturity, age at first kidding, service period, gestation length, litter size, post-partum heat period, kidding interval were monitored according to Table 2.

**Table 1:** Measuring techniques, equipment and unit of productive traits

Parameters	Measuring techniques	Measuring equipment	Unit
Birth weight	Within 24 hours of birth	Digital weighing balance	kg
Body weight at 3, 6, 9 and 12-month of age	Measured in the morning before the animals were fed	Digital weighing balance	kg
Average daily body weight gain	Calculated by subtracting the initial live weight from the final live weight divided by the initial weight of each goat	Digital weighing balance	g

**Table 2:** Measuring techniques and unit of reproductive traits of Black Bengal goat

Parameters	Measuring techniques	Unit
Age at first heat	When the female kid shows first estrous cycle	Day
Age at first kidding	When female kid gives birth for the first time	Day
Service per conception	Average number of service required for each conception	Number
Gestation length	Day of conception to successful parturition	Day
Litter size	Number of kids born per birth per doe	Number
Post-partum heat period	Day from kidding to first standing estrus in doe	Day
Kidding interval	Interval between two consecutive parturitions	Day

**Statistical analysis**

All the data generated from this experiment were entered in Microsoft Excel Worksheet, organized and processed for further analysis. All the parameters were analyzed using Statistical Analysis System (SAS) software (SAS Institute Inc., 2009) version 9.1.3.

**Results**

**Ensure the availability of breeding bucks:**

From the field data, it was revealed that 100% farmers in the community went to the selected buck rearers of their area for serving their does and did not face any scarcity of breeding bucks for serving their does in time.

**Growth performance of Black Bengal goat**

Means along with standard errors for growth performance of Black Bengal goats in community based breeding program are presented in Table 3.

Table 3 showed that sex had a significant effect ( $p < 0.05$ ) on birth, 3-month, 6-month, 9-month, and 12-month weight. At birth, weight of male kids were significantly ( $p < 0.05$ ) higher ( $1.28 \pm 0.04$  kg) than female kids ( $1.06 \pm 0.02$ ). Subsequently body weight increased with the ages and in twelve months of age male reached  $16.91 \pm 0.46$  kg whereas females attained  $14.21 \pm 0.34$  kg.

**Table 3:** Impact of community based breeding program on growth performance of Black Bengal goat

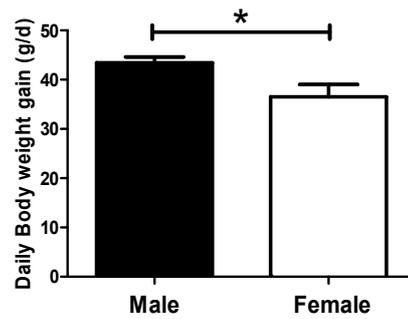
Age (months)	Body weight (kg)		Level of significance
	Male	Female	
0 (Birth weight)	$1.28 \pm 0.04$ (85)	$1.06 \pm 0.02$ (89)	*
3	$5.41 \pm 0.28$ (78)	$4.97 \pm 0.16$ (78)	**
6	$9.18 \pm 0.32$ (74)	$8.02 \pm 0.21$ (76)	*
9	$12.87 \pm 0.35$ (68)	$10.91 \pm 0.23$ (74)	**
12	$16.91 \pm 0.46$ (67)	$14.21 \pm 0.34$ (74)	**

\* Significant ( $p < 0.05$ ), \*\* significant ( $p < 0.01$ ). Parenthesis indicates the number of observation.

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### Average daily body weight gain

Table 4 shows the average daily body weight gain of Black Bengal goat progenies at different ages under community based breeding program. The effect of sex on average daily body weight gain was significant and higher daily gain was found in male kids than female from birth to twelve month of ages. The higher average daily gain was found in case of 0-3 months of age for males ( $45.89 \pm 1.21$  g) and ( $43.44 \pm 2.63$  g) for female kids although they did not show significant difference in comparison between them. However, the average daily body weight gain from 0-12 months of age was significantly ( $p < 0.05$ ) higher ( $43.42 \pm 1.17$  g) in males than females ( $36.53 \pm 2.49$  g) (Figure 1).



**Figure 1:** Average daily body weight gain from birth to twelve month of ages of Black Bengal goat

### Effect of season on growth performance

Table 5 shows the seasonal effect on the growth performance of Black Bengal goat in community based breeding program. Season had a significant effect ( $p < 0.05$ ) on weight at birth, 3-month, 6-month, 9-month, and 12-month of age. The highest birth weight was found in case of winter season ( $1.38 \pm 0.15$  kg) rather than summer ( $1.22 \pm 0.11$  kg) and rainy  $1.09 \pm 0.16$  kg) as well as the body weight also found higher in winter season in the subsequent ages (Table 5).

### Reproductive performance

Means along with standard errors of reproductive performance of Black Bengal does under community based breeding program are illustrated in the Table 6. Black Bengal does attained puberty in  $199.32 \pm 2.41$  days whereas they gave birth to their first kids at  $393.23 \pm 1.38$  days with the average gestation period of  $145.73 \pm 5.42$  days. On the other hand, post-partum heat period was  $47.50 \pm 0.87$  days only.

**Table 4:** Average daily body weight gain of Black Bengal goat progenies

Age (month)	Body weight gain/day (g)		Level of significance
	Male	Female	
0-3	$45.89 \pm 1.21$ (78)	$43.44 \pm 2.63$ (78)	NS
3-6	$41.89 \pm 1.12$ (74)	$33.89 \pm 2.43$ (76)	**
6-9	$41.00 \pm 0.94$ (68)	$32.11 \pm 1.36$ (74)	**
9-12	$44.89 \pm 1.37$ (67)	$36.67 \pm 1.48$ (74)	**

\*Significant ( $p < 0.05$ ), \*\*significant ( $p < 0.01$ ); NS, Not-significant. Parenthesis indicates the number of observation.

**Table 5:** Effect of season on growth performance of Black Bengal goat

Season	Weight at different ages (kg)				
	Birth	3-month	6-month	9-month	12-month
Winter	$1.38^a \pm 0.15$ (52)	$5.84^a \pm 0.69$ (44)	$9.19^a \pm 0.76$ (41)	$12.89^a \pm 0.49$ (38)	$15.37^a \pm 0.65$ (38)
Summer	$1.22^b \pm 0.11$ (58)	$5.12^a \pm 0.36$ (53)	$8.07^b \pm 0.68$ (51)	$10.42^b \pm 0.45$ (47)	$13.52^b \pm 0.46$ (47)
Rainy	$1.09^c \pm 0.16$ (64)	$4.24^b \pm 0.15$ (59)	$7.28^c \pm 0.19$ (58)	$10.29^b \pm 0.29$ (57)	$14.89^a \pm 0.31$ (56)
<b>Sig. Level</b>	*	*	*	*	*

\*Significant ( $p < 0.05$ ). Means with different superscripts within each column differed significantly ( $p < 0.05$ ). Parenthesis indicates the number of observation.

## **Discussion**

### **Availability of breeding bucks:**

In the present study, community based breeding program ensures the availability of breeding bucks to serve their does in the community in time. Previously, Khandoker *et al.* (2011) reported acute scarcity of Black Bengal breeding bucks in the rural areas and farmers had to go a long distance to serve their does. Moreover, in community based breeding approach, bucks can be rotated among these three areas to avoid inbreeding and improved the performances of Black Bengal goat.

### **Growth performance of Black Bengal goat**

#### **Birth weight**

The average birth weight of the male and female kids in this study was found  $1.28 \pm 0.04$  and  $1.06 \pm 0.02$  kg and the result is in agreement with the findings of Husain *et al.* (1996). Haque (2014) found that the average birth weight of Black Bengal kids at BAU, and Modhupur were  $1.08 \pm 0.09$  and  $1.21 \pm 0.07$  respectively. Paul *et al.* (2011) also reported that the average birth weight of Black Bengal kids in nucleus breeding flock (NBF), Modhupur, and Nilphamari were  $1.09 \pm 0.27$ ,  $1.09 \pm 0.25$ , and  $1.10 \pm 0.27$  kg, respectively. These results are almost similar with the result of the present study. Though these results are similar but the present finding indicates the improvement of birth weight which might be due to selective breeding by the good quality breeding bucks at the community level.

However, the present result of birth weight differ with the findings of Bhowmik *et al.* (2014) and Ali *et al.* (2016) who found birth weight of the Black Bengal kids as  $0.89 \pm 0.09$  kg and  $0.96 \pm 0.01$  kg, respectively in semi-intensive system. This variation might be due to age, parity, and litter size of the dam and management practices. Moreover, selective breeding under community based breeding program and scientific management of rearing might improve the birth weight of Black Bengal goat.

#### **Body weight at different ages**

In the present study, the average body weight at 3-month of age was found 5.19 kg which is almost similar with the results of Akhter (2018), Dhara *et al.* (2011) and Paul *et al.* (2011) where they found that the body weight at 3-month of age was 5.14, 5.03, and 5.2 kg, respectively. But on the other hand, Ali *et al.* (2016) and Islam *et al.* (2016) reported that the body weight at 3-month of age were  $4.25 \pm 0.06$  and  $4.67 \pm 0.15$  kg,

respectively which is lower than the result of present study.

Dhara *et al.* (2011) reported that the average body weight of male and female Black Bengal goat at 6-month of age were 7.27 and 6.78 kg, respectively which is lower than the result of  $9.18 \pm 0.32$  and  $8.02 \pm 0.21$  kg, respectively found in this present study. In contrast, almost similar result was found from the findings of Akhtar (2018) who reported an average body weight at 6-month of age was 8.48 kg.

The average body weight at 9-month of age was found 11.89 kg in this study which coincides with the results of Akhter (2018) who reported that the body weight of the kids at 9-month of age as 11.75 kg. The body weight at 9-month of age is significantly influenced by sex where male kid being higher body weight than those female kids at the same age. On the other hand, the average body weight at 12-month of age was found 15.56 kg in this study which is corresponding with the output of the Akhtar (2018) and Paul *et al.* (2011) who reported that the average body weight at 12-month of age were 12.18 and 12.40 kg, respectively which were little bit lower than the present result. From these results, it is indicated the improvement of growth performance at different ages using selected breeding bucks at the community and awareness on scientific rearing and management of Black Bengal goat.

#### **Average daily body weight gain**

Average Daily Gain (ADG) is the average amount of weight that an animal will gain each day during the feeding period and is influenced by several factors like available nutrients, hormones, enzymes, and environmental factors like increased ambient temperature (Padodara and Ninan Jacob, 2013). In the current study, the average daily body weight gain of Black Bengal goat at 0-3, 3-6, 6-9 and 9-12 month of age were found 44.67, 37.89, 36.56 and 40.78 (g/d) respectively which is in agreement with the finding of Nazim *et al.* (2014) who worked on five categories of Black Bengal goat and found 39.00, 35.24, 42.21, 37.13 and 38.95 (g/d), respectively. In contrast, Khan and Singh (1989) reported that the average daily gain of Black Bengal goat from birth to 3-month of age was 51.87 (g/d) which is higher than this study. This variation might be due to litter size, milk availability of the dam and management practices. Moreover, the present study revealed the significant effects of sex on ADG at different ages. The significant effect of the sex of kid on traits related to growth may be due to the

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aggressive behavior of males kids during feeding and suckling (Hafez, 1993) and due to secretion of different sexual endocrine hormones in males (Baneh and Hafezian, 2009) that could be one of the important reasons for lowering body weight in female compared to male (Rashidi *et al.*, 2008).

### Seasonal effect on growth performance

Significant effect of season was found ( $p < 0.05$ ) on weight at birth, 3-month, 6-month, 9-month, and 12-month of age. Similar finding was reported by Yaqoob *et al.* (2009) in Dera Din Panah goat. The findings of other studies (Abraham *et al.*, 2019; Mourad *et al.*, 2000) also supported the findings of this present study. However, Mourad *et al.* (2000) found insignificant effect of season on the body weight of kids. The indirect effects of season on animal performance result mainly from alterations in the nutritional environment. As seasonal changes would affect the quality and quantity of forage production (Topp and Doyle, 1996) that also influence on the growth performance of the individual animal.

### Reproductive performance

#### Age at sexual maturity

The average age at sexual maturity was  $199.32 \pm 2.41$  days in this study which is analogous to the results of Ali *et al.* (2016) and Faruque *et al.* (2010) who reported that the age at first heat in Black Bengal goat were  $200.60 \pm 2.83$  and  $197.82 \pm 12.58$  days, respectively under semi-intensive rearing system. The result is also in agreement with the findings of Khan *et al.* (2013), Bhowmik *et al.* (2014),. In contrast to this, Akter *et al.* (2006) and Akhtar (2018) reported that the average age at first heat of the kids were  $281.02 \pm 9.93$  and 233 days, respectively under semi-intensive rearing system which is significantly higher than the findings of this present study. The difference might be due to body weights during sexual maturity that have a positive correlation with the availability of quality and quantity of feeds rather than age of the individual animal (Bushara and Abu Nikhaila, 2012). Moreover, the puberty is directly related with the body weight not the ages.

#### Age at first kidding

Age at first kidding is expressed as the age at which does kid for the first time. In the present study, the mean age at first kidding was recorded as  $393.23 \pm 1.38$  days which corroborates to the result of Akhtar (2018), Roy *et al.* (2016). On the other hand, Faruque *et al.* (2010) reported age at first kidding of Black Bengal goat to be 283 day in case of intensive management system that value was lower than the present finding which might

be due to the seasonal effect and the female kids born during season with ample feed grow faster, attain sexual maturity earlier and give first kidding at younger age (Bushara and Nikhaila, 2012).

**Table 6:** Reproductive performance of Black Bengal does under community based breeding program

Traits	Performance
Age at sexual maturity (d)	$199.32 \pm 2.41$ (74)
Age at first kidding (d)	$393.23 \pm 1.38$ (64)
Service per conception (no.)	$1.17 \pm 0.04$ (64)
Gestation length (d)	$145.73 \pm 5.42$ (61)
Litter size (no.)	$1.76 \pm 0.08$ (58)
Post-partum heat period (d)	$47.50 \pm 0.87$ (45)
Kidding interval (d)	$187.06 \pm 1.09$ (41)

Parenthesis indicates the number of observation.

#### Service per conception

Service per conception (SPC) is frequently used as an indicator of fertility of an individual. Chowdhury *et al.* (2002) worked on Black Bengal goats and reported that the average number of service required for conception were  $1.59 \pm 0.69$ ,  $1.45 \pm 0.3$  and  $1.57 \pm 0.14$ , respectively which are significantly higher to the result of the present finding  $1.17 \pm 0.04$ . But similar result was found from the output of Dhara *et al.* (2011).

#### Gestation period

The average gestation period in the present study was  $145.73 \pm 5.42$  days which is comparable with the result of Ali *et al.* (2016), Bhowmik *et al.* (2014), Haque (2014), and Khan *et al.* (2013). Both genetic and environmental factors affect the length of gestation period such as age of mother, number of kids, nutrition, sex of the kids, season of conception and photoperiodic influence.

#### Litter size

Litter size is considered as one of the major criteria to evaluate the ability of goat prolificacy which is influenced by both genetic and environmental factors. From the present study, it was found that the average litter size ( $1.76 \pm 0.08$ ) of Black Bengal goats which is almost same with the results of Amin *et al.* (2000) and Haque (2014) who reported  $1.9 \pm 0.56$ , 1.86,  $1.61 \pm 0.02$  litter size, respectively. Variation in litter size may be due to the interaction of genetics and environment, status and age of the dam, parity.

### Post-partum heat period

Post-partum heat period plays an important role in determining the kidding interval. In this study, average post-partum heat period was  $47.50 \pm 0.87$  days which are closely related to the finding of Majumdar (2011) whose value was  $46.31 \pm 2.34$  day. Haque (2014), and Rume et al. (2011), found the average post-partum heat period  $123.84 \pm 1.85$  and  $95.33 \pm 2.60$  days, respectively which are higher than the result of the present study. Apart from genetics, several factors can influence the length of the post-partum heat period, including uterine involution, short cycling, suckling effects, and nutritional status, season of parturition (Rojero et al., 2005) and management system.

### Kidding interval

Kidding interval is calculated as the difference in days between two successive kidding and in this study it was observed that the average kidding interval was  $187.06 \pm 1.09$  days. Abraham et al. (2019) found kidding interval of does under semi intensive system ( $233.8 \pm 13.12$  days) than those of the does managed under extensive system ( $242.8 \pm 32.66$  days). These differences might be due to the effect of different management practices, insufficient food, lactation length and genetic makeup on possibilities to prompt re-conception after parturition (Gbangboche et al., 2006).

### Conclusion

Comparing with the previous research findings, it can be concluded that community based breeding program ensures the availability of the breeding bucks for service in time to the heated does and improves the growth and reproductive performance of Black Bengal goat. Therefore, this community based breeding approach may be implemented for the conservation and improvement of this valuable genetic resource in Bangladesh.

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### Conflict of interest

The authors have no conflict of interest to declare.

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