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Study the Live Weight and Live Weight Gain of Black Bengal and Jamunapari Goat Breeds by Fitting the Linear Regression under Semi-intensive Conditions

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Abstract: The present study was conducted to know the live weight gain of goats under semi-intensive conditions of Chittagong district of Bangladesh during the period of July, 2012 to January, 2013. Data were collected from 72 black Bengal and 32 Jamunapari goats and the kids birth weight and their subsequent live weight at weekly intervals up to age and weight of weaning at sexual maturity was recorded. The weight gains from birth to sexual maturity of two different breeds under 2 different farms were studied. Average birth weight of male and female black Bengal goats kids were 1.22±0.15, 1.01±0.14, 1.42±0.10 and 1.12±0.27 kg, respectively for farm 1 and 2. For Jamunapari goat's kid birth weight were 1.51±0.07 and 1.42±0.09 kg, for male and females, respectively in the farm 2. The average weaning age was 4 months and the average weaning weight of male and female black Bengal goats were 5.19±0.358, 5.05±0.28, 5.63±0.61 and 5.54±0.41 kg, in the farm 1 and 2, respectively. However, the average weaning weight of male and female Jamunapari was 6.59±0.69 and 6.79±0.31 kg, respectively in farm 2 which was higher than black Bengal. The average age at sexual maturity of black Bengal goat was 8 months. The average weight at sexual maturity of male and female black Bengal goats were 9.82±0.75 and 9.52±0.62 kg, respectively in farm 1 and 9.65±0.75 and 9.138±0.70 kg, respectively in farm 2. The average age at sexual maturity was 9 months for Jamunapari goat. The average weight at sexual maturity of male and female Jamunapari goats was 13.2±0.75 and 14.1±0.82 kg, respectively. The average daily body weight gain from birth to weaning for male and female black Bengal goat was 33.70, 35.11 g day^{-1} and was 35.67 and 45.94 g day^{-1}, respectively in farm 1 and 2 and for Jamunapari goat was 42.97 and 45.47 g day^{-1}, respectively. The males were grew faster than the females. The predicted live weight gains for both breeds were lowered after fitting the linear regression. The co-efficient of determination (R^2) of male and female black Bengal and Jamunapari goats kids similar.

Key words: Goats, live weight, weight gain, sexual maturity, semi-intensive

INTRODUCTION

The goats population of Bangladesh is 25.17 million (DLS, 2010) which constitutes about 7% of the total Asiatic goat population. The available goat breeds of Bangladesh are black Bengal, Jamunapari and their crosses. Among them 90% of the goat is black Bengal goat and remaining 10% are Jamunapari and their crosses. The Jamunapari goats are originated in Uttar Pradesh and it is the tallest goat breed in the world. However, the number of this breed in Bangladesh is not known, but is found throughout the country (Faruque and Khandoker, 2007). It is dual purpose breeds for its milk as well as meat production. However, it is also prolific, twin and triplet births are common (Khan and Singh, 1989). It has proven to be most suitable to tropical climates and has consequently been used widely for upgrading indigenous

stock for meat and milk. Black Bengal goats graze on barren and road-side land with grass and least homemade supplies such as rice gruel, various tree leaves such as jackfruit leaves, mango leaves etc. But in case of Jamunapari goat most of farmers fed them wheat bran, motor bran, gram chuni, banana residues in addition to the above mentioned feed ingredients.

Recently, goat rearing is considered as an effective tool for poverty alleviation as it requires less investment and less rearing cost. The government of Bangladesh has been adopted a programme on goat rearing to reduce the poverty. Different Non Government Organizations (NGOs) has also been coming up for poverty alleviation through black Bengal goat distribution.

Mathematical models such as linear regression, multiple regression, logistic and non-linear models can assist in understanding of farming system by estimating

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the productivity from the incomplete or partial collected data (Khan and Ahmed, 2010). It also reduces the confusion for calculating the yield by estimating its parameters. The different fit statistics such as R^2, Root Mean Square Error (RMSE) and Co-efficient of variation (COV) can be used to study the fitness of actual and predicted data. The higher the R^2 value higher the fitness (Khan *et al.*, 2012).

In Bangladesh the farmers are rearing goat under extensive system and in this system control measures on feeding, vaccination and treatment is not possible. If semi-intensive systems could be introduced which will allow to use all the measures. How the production systems would affects on live weight, live weight gain and other productive traits has not been any clear indication. Moreover, very little number of findings is available for semi-scavenging system with different breeds. Therefore, the current study was undertaken with the objectives (1) To know the weight at birth, weight and age at weaning and sexual maturity of goats and (2) To know the weight gain up to weaning and sexual maturity by fitting the linear regression equation.

MATERIALS AND METHODS

The study was conducted at two farms in Panchlaish Thana under the district of Chittagong of Bangladesh from July 2012 to January 2013.

Management of goats: The goats were kept in the dry and high placed bamboo sliced made well ventilated house with sufficient floor spaces. Fifteen goats were reared in one shed. There was no separate shed for male or female and for kids of black Bengal goat and Jamunapari goat. The goat was allowed to graze in the field about 5-6 h. Feed was provided three times in a day at morning, noon and afternoon and keep adequate water supply during feeding. In addition, some concentrates like broken rice, rice gruel, wheat bran, motor bran, gram chuni, banana residues was supplied and during the scarce period of time they fed the goats tree leaves, herbs, etc., Kids are fed milk from their dam up to weaning. All does were naturally mated. At the end of estrus the goats were allowed for natural service. A matured buck is used for 25-30 does. Regular/periodic de-worming is practiced. Goats are vaccinated against PPR. A veterinarian are regularly inspecting the farm to observe the health status of goat and treated them if the goats are suffering from any diseases or diseases condition like anorexia, diarrhea, PPR, difficulty of kidding.

Study of live weight and live weight gain: Data were collected from 72 black Bengal goats and 32 Jamunapari

goats of 2 different farms. Birth weight of kids was taken within 24 h after birth. The kids birth weight and subsequent live weight at weekly interval up to sexual maturity were recorded for estimates the birth weight, weight gains and age and weight at weaning up to sexual maturity. The goats were weighted by top loading balance during the study period.

Fitting the linear regression equation: The linear regression y = a+bx (where, x is the ages of goats and a and b are the parameters that define the shape of the curve) used to fitting the observed values of birth to weaning and weaning to sexual maturity. To obtain the model parameters, a (intercept), b (slope) and fit statistics, R^2 (Co-efficient of determinant) the above linear model was fitted with Microsoft Office Excel 2007.

Statistical analysis: The collected data were unequal which was tabulated in Excel and edited. The collected data were analyzed by using the statistical package (SAS, 2000). The following statistical models were used to obtain the least square means with standard error of all parameters.

The model is given as:

$$Y_{ijkl} = \mu + B_i + S_j + F_k + e_{ijkl}$$

where, Y_{ijkl} is value of the traits, μ is the overall mean, B_i is the effect of Breed and S_j is the sex effect, F_k is the effect of farm, e_{ijkl} is the random error.

The mean differences were compared using least significant difference that (lsd) (Steel *et al.*, 1997) at 5% level of significance.

RESULTS AND DISCUSSION

Birth weight: The birth weight of black Bengal and Jamunapari goat's kids in two different farms is shown in Table 1. Average birth weight of male and female black Bengal goats kids were 1.22±0.15, 1.01±0.14, 1.42±0.10 and 1.12±0.27 kg, in farm 1 and 2, respectively. From Table 1, it can be seen that the birth weight of male and female were varied in two different locations. The average birth weight of black Bengal male kids were higher than the female kids in both locations. However, the average birth weight of male and female black Bengal kids of farm 2 were higher than farm 1.

The average birth weight of Jamunapari male kids (1.51±0.07) were higher than female kids (1.42±0.09 kg). The average birth weights of both sexes of Jamunapari were higher than black Bengal goats. The birth weight depends on breed, feeding, location, care and management e.g., over all health hygiene of pregnant

Table 1: Birth, Weaning and sexual maturity weight (kg) and weight gain (g day^{-1}) from birth to sexual maturity of black Bengal goats and Jamunapari Goats under two different farm

	Breed					
	Black Bengal goat				Jamunapari goat	
	Farm 1		Farm 2		Farm 2	
Traits	Male	Female	Male	Female	Male	Female
Birth weight (kg)	1.22±0.15	1.01±0.14	1.42±0.10	1.12±0.27	1.51±0.07	1.42±0.09
Weaning weight (4 months) in kg	5.19±0.35	5.05±0.28	5.63±0.61	5.54±0.40[a]	6.59± 0.69	6.79±0.31[b]
Sexual maturity weight (at 8 and 9 months for black Bengal and Jamunapari Goat, res.) (kg)	9.82±0.75	9.52±0.62	9.65±0.42[a]	9.13±0.70[a]	13.2±0.75[b]	14.1±0.82[b]
Growth rate g day^{-1} (Birth to weaning)	33.70	35.11	35.67	45.94	42.97	45.47
Growth rate g day^{-1} (weaning to sexual maturity)	27.99	25.91	34.22	26.40	42.43	43.47

Letter a and b in the superscript indicated 5% (p<0.05) level of significant

does. In this study the average birth weight of male kids at farm 2 were higher than farm 1. In case of female kid's birth weight were higher in farm 2 than 1. Comparatively male kids birth weight showed different between two farms than female kids. There was a negative association between birth weight and Litter size. In this study the birth weight of black Bengal goat was similar with Talukder *et al.* (2010) but lower than Khan and Khatun (2013), they reported birth weight of kids 1.0-1.3 and 1.5-1.9 kg, respectively. Hassan *et al.* (2010) found the mean body weight of Jamunapari kid was 1.6 kg at birth which was similar to present study.

Weaning weight: The weaning weights of black Bengal and Jamunapari goats are presented in Table 1. The average weaning weight of male and female black Bengal goats were 5.19±0.358, 5.05±0.28, 5.63±0.61 and 5.54±0.41 kg, respectively for farm 1 and 2. From Table 1, it was found that the average weaning weight of male black Bengal goat was higher than female in both farms. The reverse results were observed for female kids. However, the average weaning weight of male and female black Bengal kids of farm 2 were higher than farm 1. The average weaning weight of male and female Jamunapari was 6.59±0.69 and 6.79±0.31 kg, respectively in farm 2. The average weaning weight of Jamunapari female was higher than Jamunapari male. Though the birth weight of Jamunapari male was higher than female kids but the weaning weight of female Jamunapari was higher than male Jamunapari goat. The average weaning weight of male and female Jamunapari was higher than male and female black Bengal for both farms. In the current study the weaning weight of black Bengal goat was similar with Chowdhury *et al.* (2002) but lower than Khan and Khatun, (2013). They reported weaning weight of goats 4.87-5.5 and 6.5 to 7.5 kg, respectively.

Age and weight at sexual maturity: The age and weight at sexual maturity of black Bengal and Jamunapari goats are presented in Table 1. The average weight at sexual maturity of male and female black Bengal goats were 9.82±0.75, 9.52±0.62, 9.65±0.75 and 9.138±0.70 kg in farm 1 and 2, respectively. From Table 1, it was found that the average weight at sexual maturity of male black Bengal goat was higher than female in both farms. The reverse results were observed for female kids. However, the average weight at sexual maturity of male and female black Bengal goats of farm 1 was higher than 2. Though the weaning weight of male and female black Bengal goats of farm 2 were higher than 1.The average age at sexual maturity of male and female Jamunapari goat was 9 months which was higher than black Bengal goat. But the black Bengal goat attained sexual maturity at an early age than Jamunapari goat. The average weight at sexual maturity of male and female Jamunapari goats was 13.2±0.75 and 14.1±0.82 kg, respectively in farm 2. The average weight at sexual maturity of female Jamunapari goat was higher than male. The average age and weight at sexual maturity of male and female Jamunapari goats were higher than male and female black Bengal goats.

In the current study the age at sexual maturity of black Bengal goat was 8 months which was similar with Amin *et al.* (2001) but higher than Khan and Khatun, (2013), Rume *et al.*, (2011) and Hassan *et al.* (2007). They reported that age at sexual maturity of goats were 7.2±0.18 kg. In this study the weight at sexual maturity of black Bengal goat was 9-9.8 kg which was similar with Rume *et al.* (2011), Hassan *et al.* (2007), Hossain *et al.* (2004), Chowdhury *et al.* (2002). They reported that weight at sexual maturity was 8.89±0.33 kg. In the current study the age at sexual maturity of Jamunapari goat was 270 days, where Hassan *et al.* (2010) found 354.7±17.1 days which was higher than present study. The variation of results was occurred due to genetic cause. Chowdhury *et al.* (2002) observed that season and feeding level of were affected of age at first heat but rearing system did not affect the age of puberty. Besides genetically influence, feeding and management are

important in respect of age of puberty. The management includes feeding, breeding, housing and disease control which affect the age at puberty.

Average daily live weight gain
Birth to weaning: The average daily body weight gain from birth to weaning is presented in Table 1.The average daily body weight gain from birth to weaning for male and female black Bengal goats was 33.70 and 35.11 g day^{-1}, respectively, in farm 1. In case of farm 1, the average daily body weight gain from birth to weaning of female black Bengal goat was higher than male black Bengal goat, although the average birth and weaning weight of female was lower than male. Therefore, it can be seen that the female goat attained more weight than male black Bengal goat in farm 1. But the average daily body weight gain from birth to weaning for male and female black Bengal goat is 35.67 and 45.94 g day^{-1}, respectively in farm 2. On the other hand the average daily body weight gain of female is higher than male (farm 2). But in farm 2 average daily weight gain of male and female is higher than male and female of black Bengal goat farm 1. But in farm 2 the average daily body weight gain from birth to weaning for male and female Jamunapari goat was 42.97 and 45.47 g day^{-1}, respectively. The average daily weight gain of female was higher than male. Therefore, female attained more weight than male black Bengal goat in farm 1. In both farm the average daily weight gain of female was higher than male for 2 different breed. But average daily weight gain of female black female black Bengal goat of farm 2 was attained highest gain than Jamunapari and also farm 1. Although, the average weaning weight of male and female Jamunapari was higher than male and female black Bengal for both farm. In the current study the average daily body weight gain from birth to weaning was 34-45 g day^{-1} which was similar with Husain *et al.* (1997) and Khan and Singh (1989). They observed average daily body weight gain was 35-45 g day^{-1}.

Weaning to sexual maturity: The average daily body weight gain from weaning to sexual maturity are presented in Table 1.The average daily body weight gain for male of black Bengal goat was higher than female, although the average birth to weaning weight gain of female was higher. This difference was due to that in earlier stage the kids grew faster than the older age and was the effect of age sex and management. This result was similar with Husain *et al.* (1997), they reported that the average daily body weight gain weaning to sexual maturity was 44-55 g day^{-1}. The average live weight gain decreased significantly with increase in age (Husain *et al.*, 1997).

Fitting the regression equation: After fitting the regression equation, with the data on birth weight to age at sexual maturity of different goat breeds the regression parameters and the value of R^2 are presented in Table 2. The intercept and slope of male black Bengal under farm 1 and Jamunapari goat was 0.429, 0.278, 0.966 and 0.310, respectively. The intercept and slope of Jamunapari goat was higher than black Bengal goat under farm 1. The co-efficient of determination (R^2) of male black Bengal under farm 1 and Jamunapari goat was 0.992 and 0.998, respectively. The R^2 value of male Jamunapari goat was higher than black Bengal goat. So the value of male Jamunapari goat was more fitted. The higher R^2 values considered as superior (Khan *et al.*, 2012). The intercept and slope of female black Bengal and Jamunapari goat was 0.252, 0.275, 0.603 and 0.343, respectively. The intercept and slope of female Jamunapari goat was higher than black Bengal goat under farm 1.

The co-efficient of determination (R^2) of female black Bengal under farm 1 and Jamunapari goat was 0.994 and 0.956, respectively. The R^2 value of female was higher than Jamunapari goat. So the value of black Bengal goat was more fitted. The intercept and slope of male black Bengal and Jamunapari goat was and 0.938, 0.259, 0.966 and 0.310, respectively under farm 2. The intercept and slope of male Jamunapari goat was higher than black Bengal goat under farm 2. The co-efficient of determination (R^2) of male black Bengal under farm 2 and Jamunapari goat was 0.996 and 0.956, respectively. The value of male black Bengal goat under farm 2 was higher than Jamunapari goat. So the value of male black Bengal

Table 2: The regression parameters and R^2 values after fitting the regression equation, with the birth weight to age at sexual maturity of different goat breeds

	Breed					
	Black Bengal goat				Jamunapari goat	
	Farm1		Farm 2		Farm 2	
Traits	Male	Female	Male	Female	Male	Female
a (intercept)	0.429	0.252	0.938	0.827	0.966	0.603
b (slope)	0.278	0.275	0.259	0.256	0.310	0.343
R^2 (co-efficient of determination)	0.992	0.994	0.996	0.997	0.998	0.956

goat was more fitted. The intercept and slope of male black Bengal under farm 1 and 2 was 0.929, 0.278, 0.938 and 0.259, respectively. The intercept of male black Bengal goat under farm 1 was higher than 2. The co-efficient of determination (R^2) of male black Bengal under farm 1 and 2 was 0.992 and 0.996, respectively. The R^2 value of male black Bengal goat Under farm 2 was higher than 1. From Table 2, it showed that the highest R^2 value 0.998 was observed in male Jamunapari goat. So the R^2 value 0.998 was more fitted and superior. In this study the R^2 value was higher than Khan *et al.* (2012). They observed the R^2 value was 0.93-0.95. However, the growth of goats could be influenced by sex, season, age, management. Similar factors were identified by various researchers (Najari *et al.*, 2007; Thiruvenkadan *et al.*, 2010).

CONCLUSION

The study reveals that the average birth weight, weaning weight, weight at sexual maturity and weight gain from birth to weaning, weaning to sexual maturity of male and female of black Bengal and Jamunapari goats were different in between farm. The study also showed that the weight gain of goat depends on birth weight, balance feeding, presence or absence of diseases, available milk from mother and management of kids. But some constraints in this study were small population size, presence of diseases, limited time and seasonal differences. However, more study with larger studied population and in different geographical region is recommended for making final comments.

ACKNOWLEDGMENTS

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