EVALUATION OF PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF BLACK BENGAL GOATS IN RAJSHAHI GOVERNMENT GOAT DEVELOPMENT FARM IN BANGLADESH

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ABSTRACT

Background: The Black Bengal goat (BBG) is well adapted food animals with profitable productive and reproductive traits being naturally reared to enhance economic status and food security in rural people. Bangladesh government has taken program through establishment of 'Government Goat Development Farms' (GGDF) to enhance the goat rearing activities of the smallholders at rural level but the research reports on the productive and reproductive performances of goats in these GGDF are very limited.

Objective: The main objective of this study was to evaluate the productive and reproductive performances of the BBG reared in semi-intensive system at the Rajshahi GGDF

Materials and Methods: The Rajshahi GGDF had 398 goat populations of which 121 does were selected to study the productive and reproductive performances during the period from July 2010 to June 2011. The age of first estrus, conception rate by natural service, gestation length, post-partum heat, kidding interval, litter size, survivability of kids, morbidity and mortality of kids and their seasonal influence were studied.

Results: The age of young female BBG showed 1st estrus varied from 180 to 270 with an average of 204 ± 27 days. The conception rate varied from 88 to 100 with an average of 97% with natural services. The gestation length varied from 145 to 182 with an average of 150 ± 5 days. The post-partum heat period varied from 60 to 90 days with an average of 69 ± 7 days. The kidding interval varied from 199 to 268 with an average of 219 ± 13 days. The litter size varied from 1 to 3 with an average of 2. Out of 234 kids borne, 47.44% were male and 52.56% female with higher mortality in male (10.81%) than female (5.69%) with an overall average mortality of 8.12%. There was no significant influence of season and parity on the birth weight of kids. However, the heavier birth weight of kids was recorded in male (1.38 kg) than female (1.17kg) kids. The birth of twin kids (56.41%) was found significantly ($p < 0.0001$) highest in comparison to triplets (26.92%), single (11.54%) and quadruplet (5.13%).

Conclusions: The results support promising breeding and reproductive efficiency of BBG under local environmental conditions and therefore, there is a need to be improved milk yield of dam and control of morbidity and mortality in BBG kids. It may be concluded that the productive and reproductive performances of the BBG reared by using semi-intensive system of management appears to be encouraging at the Rajshahi GGDF which could be extended and compared to research findings with other four GGDF in Bangladesh.

Keywords: Black Bengal goats, Goat Development Farm, Productive and Reproductive Performances, Semi-intensive management

INTRODUCTION

Goat is considered as the first animals to be domesticated and linked to humans for at least 10,000 years.[1] Goats are adapted to a wide variety of harsh environment and thus play key roles as providers of nutrition (meat & milk), food security, self-employment and socio-economic development to their human owners in many low-income groups of population in developing world. Bangladesh has a native goat breed commonly known as the Black Bengal goat (BBG) reputed for its prolificacy, fertility, early sexual maturity and adaptability to hot-humid environment. Goats are valued for their contribution in the national economy of Bangladesh in different ways which include: (a) meat for human consumption, (b) leather for earning foreign currency, (c) increase of income and poverty reduction for smallholders, (d) employment generation in rural areas and (e) cash income for empowered of women. Goat population is about 26.267 million in Bangladesh in the year 2018-2019,[2] of which about 90% are BBG, 8 to 9% Jamunapari and rest other exotic breeds (Sirohi, Beetal) and their crosses.[3] Approximately, 98% of goats are owned by the small, marginal and landless farmers in the villages. Most of the smallholder farmers (80.5%) reared goats in semi-intensive system but few farmers (7.3%) used confinement system while 12.2% farmers used free range system in Bangladesh.[4] Approximately 96% farmers used roadside grass and tree leaves whereas only 4% farmers used cultivated fodder to feed their indigenous goats.[5] The dairy goats are aptly said to be 'poor man's cow' because in proportional terms to its size and feed intake, the milk yield of the goat is often remarkable. The goat has a reduced food intake, its feeding is cheap, it is a small animal and easy to handle by women and children and each goat produces enough milk to feed an average family. Comparatively and due to its size, the cow has very high maintenance costs and is more difficult to maintain at home. The Research reports on the evaluation of the productive and reproductive performances of BBG maintained under intensive, semi-intensive and extensive systems have been published from Bangladesh.[6-12] The Department of Livestock Services (DLS) has established five 'Government Goat Development Farms' (GGDF) which are in Dhaka, Sylhet, Rajshahi, Chuadanga and Jhenaidah districts in Bangladesh. The objectives of these goat farms are: (a) conserve and extension of BBG breed, (b) buck production and (c) distribution of buck to poor and distressed women and unemployed youth. Some training, research and extension services are in progress at different universities, research institutions and non-government organization (NGO) by using goat as a tool for poverty alleviation and livelihood improvement of rural poor smallholders in Bangladesh.[13] However, research reports on the BBG from these GGDF are very limited.[14] This paper describes the productive and reproductive performances of BBG of the Rajshahi GGDF in Bangladesh.

MATERIALS AND METHODS

The BBG have already been recognized as a famous native breed for its adaptability, higher disease resistant, fertility, fecundity, early sexual maturity, larger litter size, delicacy of meat and superior skin quality. A study on the productive and reproductive performances of BBG was carried out at the Rajshahi GGDF during the period from July 2010 to June 2011. All goats were housed in permanent house with slated platform of about four meters above the ground. The goats were reared under semi-intensive system and they were also provided with some cut

and carry green grass in addition to natural pasture and concentrate diet @ 2% of body weight were supplied. These goats were kept together in common shed but at peri-parturient period (advance pregnancy and lactation stages) were maintained in separate sheds at short distance from each other in a house. Bucks were managed in separate shed used to natural services of the goats of the farm.

A selective breeding program was conducted to improve the economically important traits like birth weight, growth rate, live weight, milk yield, prolificacy, survivability and feed efficiency. The sign of heat was observed using a buck in the morning. Does came in estrus were naturally mated with the buck.

The age at first estrus, conception rate by natural service, gestation length, post-partum heat, kidding interval, number of kids borne, survivability of the kids, morbidity and mortality rates were recorded for analysis. The birth weights (kg) of newborn kids were taken by digital weighing balance within one hour of birth. The data were analyzed based on three seasons to detect any seasonal influences which includes summer (March to June), rainy (July to October) and winter (November to February) seasons. All the relevant data on productive and reproductive performances of BBG were recorded and analyzed by using χ^2 and single t test with the help of SPSS version 17.0 Statistical computer program.

RESULTS AND DISCUSSION

The rural population in Bangladesh in 1964 was 94.87% and in 2016 it was 64.97% and by 2030 the Bangladesh urban population will overtake rural population.[15,16] The main livelihood of the rural people is characterized by smallholdings or landless, illiteracy, unemployment and malnutrition. Many of these rural people resort goat production to assist in reaching self-sufficiency. Women and children employ their labor in goat rearing as a subsidiary occupation. Therefore, goats are considered to play an important role in generating employment, income, capital, storage and improving household nutrition.[17] However, rapid increase of population and urbanization of rural people has increased the demand of animal sources of protein but such production is not adequate to meet up the demand of urban population. To enhance the production potential of the rural goats, it is essential to improve the breed, technologies, feeding and breeding system with improved husbandry practices in goat rearing. Review of literature reveals that the BBG is one of the best breed in comparison to other local breeds in relation to reproductive performance under local agro-climatic condition for economic goat rearing both in Bangladesh[6,9,18,19] and India.[17,20] So far only five government goat development farms have been established to reduce the poverty, enhance economic status and employment to rural people by using BBG in Bangladesh. Although some training and extension activities on BBG rearing are somewhat extended to the rural level but research reports from these GGDF is very limited.[14]

Goats are called small ruminants that can naturally be adapted to different environment, and they are raised for various purposes which include business and human consumption of meat and milk production. Two reasons for the goats' ability to survive in some of the most inhospitable regions of the world are their exceptional tolerance to heat stress and ability to grow on poor quality feed. Therefore, goat production is equally suited to marginal farming

areas, small farms or large-scale production in the tropics and sub-tropics. Table 1 shows the results on the productive and reproductive performances of 121 BBG of Rajshahi GGDF.

Table 1. Productive and reproductive performances of Black Bengal goats at Rajshahi Goat Development Farm in Bangladesh during July 2010 to June 2011

SN Parameters	Seasons [Range, Mean ± SD]			
	Rainy (n = 49)	Winter (n = 37)	Summer (n = 35)	Overall (n = 121)
1. Age at 1st estrus (days)	180-240 196 ± 23	180-270 216 ± 31	180-240 201 ± 21	180-270 204 ± 27
2. Conception rate (%)	92-100 96	91-100 98	88-100 97	88-100 97
3. Gestation length (days)	145-156 151 ± 3	145-167 154 ± 7	145-182 153 ± 5	145-182 150 ± 5
4. Post-partum heat (days)	60-79 70 ± 9	60-90 72 ± 9	61-81 70 ± 6	60-90 69 ± 7
5. Kidding interval (days)	200-240 224 ± 9	206-250 227 ± 11	199-268 235 ± 17	199-268 219 ± 13
6. Litter size (No.)	1-4 (2)	1-3 (2)	1-3 (2)	1-3 (2)

Age of first estrus

The age of first estrus in BBG was found to be varied from 180 to 270 with a mean of 204 ± 27 days (6.8 months) (Table 1). The age of first estrus in BBG has been reported in both higher and lower ages in literatures in comparison to the values of this study. The higher ages showed first estrus in goats include 10.0 ± 2.48 months,[21] 10.26 ± 1.78 months,[22] 216 days,[23] 209 days,[8] and 234.16 days.[7] Comparatively lower ages showed first estrus in goats include 180.74 days,[24] 197.82,[18] 194.12 days,[6] 197.82 days,[25,26*] 182.7 days[9] and 197.35 days,[19] in BBG.

Conception rate

The overall conception rate in BBG varied from 88 to 110% with a mean of 97% with natural services. This observation could not be compared due to lack of similar reports in the available literature. However, it has been reported as 1.2 to 1.4 services required per conception in BBG.[8]

Gestation length

The gestation length recorded in this study in BBG varied from 145 to 182 with a mean 150 ± 5 days which is in conformity with earlier reports.[20,27,28] However, lower length of gestation period in BBG have been reported with 143 days,[21] 143.09 days,[24] 148 days,[8] 145.5 days,[10] 142.8 days,[18] 145.61 days,[7] 145-148 days,[29] 146.7 days,[6] 142.45 days,[9] 147.90 days[19] and 148.52 days.[12] The gestation length was found higher in winter (154 ± 7 days), followed by summer (153 ± 5 days) and lowest in rainy (151 ± 3) seasons (Table 1). The seasonal influence

of gestation length recorded in this study contradict with the gestation length which was not affected by the seasons[23] but this finding supports the other report in which it has affected by factors like season, year and sire.[30]

Post-partum heat period

The post-partum heat period (PPHP) is the interval from kidding to post-partum estrus interval ranged from 60 to 90 with a mean of 69 ± 7 days recorded in this study (Table 1). Most of the recent reports showed comparatively shorter duration of PPHP in does than this report, which includes 43.04 days,[8] 52.1 days,[10] 33.1 days,[18] 67 days,[7] 33.39 days,[9] 36 days.[19] However, longer PPHP of 77 days[31] has also been reported. Many factors like feeding and nutrition, housing, reproductive management, improper heat detection, reproductive disorders and others may be associated with the variation of PPHP in animals. However, better nutrition might be the most important contributing factor responsible for lowering the PPHP in goats.

Kidding interval

Table 1 shows the kidding interval ranged from 199 to 268 days with an average of 219 ± 13 days (7.3 months). This result supports the earlier report of 7.46 ± 1.23 months kidding interval in goats.[22] The kidding interval recorded in this study was found much higher than the reported period of 198.51 days,[24] 209 days,[32] 193.10 days,[8] 179.0 ± 20 days,[33] 198.0 days,[10] 181.76 days,[6] 190.2 days[25,26*] 188.01 days,[9] 186.15 days[19] and 176.86 days.[12] However, much higher period of 252.45 days kidding interval has also been reported in NGO beneficiary's rural goats.[7]

Litter size

The litter size of BBG was ranged between 1 to 3 which is in conformity with 1 to 3 litter sized reported earlier.[23,33] However, 1.2 to 1.8 and 1.6 to 1.9 litter size in BBG have also been reported.[29,34] This study recorded an average of 2 litter size in BBG which compares well with the 1.60,[8] 2.16,[35] 2.0,[4] 1.06,[18] 1.68,[7] 1.06,[25,26*] and 1.75,[9] litter size reported earlier. Litter size may be affected by parity, age, genetic and environmental factors,[23,36] and also by buck used for service.[37]

Seasonality of kidding

Out of 118 goat delivered, higher percentage of goats delivered kids during rainy (39.83%, n = 47), followed by winter (30.51%; n = 36) and lowest during summer (29.66%, n = 35) seasons (Table 2). These findings are in support with the earlier report of 47.64% kidding during rainy, followed 31.41% in winter and 20.94% during summer seasons in BBG.[23]

Gender (Sex) of kids

Table 2 shows that the significantly ($p < 0.05$) lower number of male (47.44%) than female (52.56%) kids borne during this study period. This observation is reverse with published reports in which significantly higher male (69.03%) than female (30.97%) kids borne[22] and male : female kid ratio 1: 0.7.[10]

Table 2. Seasonal influence on the occurrence of estrus and parturition with outcome of kids of Black Bengal goats in Rajshahi Goat Development Farm during July 2010 to June 2011

SN Parameters		Seasons [No. (%)]				χ^2 value P value
		Rainy	Winter	Summer	Overall	Significant
1. Goats in estrus		50 (31.25)	47 (29.38)	63 (39.38)	160	
2. Goats delivered		47 (39.83)	36 (30.51)	35 (29.66)	118	
3. Kid borne,	Male	43 (38.34)	36 (32.43)	32 (28.83)	111 (47.44)	0.639
	Female	51(41.46)	34 (27.64)	38 (30.89)	123 (52.56)	0.727
	Total	**94 (40.17)**	**70 (29.91)**	**70 (29.91)**	**234 (100)**	NS
4. Kids survived	Male	37 (86.06)	33 (91.67)	29 (90.63)	099 (89.19)	1.452
	Female	49 (96.08)	30 (88.24)	37 (97.37)	116 (94.31)	0.484
	Total	**86 (91.49)**	**63 (90.00)**	**66 (94.29)**	**215 (91.88)**	NS
5. Kid mortality	Male	06 (13.95)	03 (08.33)	03 (09.38)	012 (10.81)	1.963
	Female	02 (03.92)	04 (11.76)	01 (02.63)	007 (05.69)	0.375
	Total	**08 (08.51)**	**07 (10.00)**	**04 (05.71)**	**019 (08.12)**	NS

Table 3. Effects of physiological factors on birth weight of newborns kids of Black Bengal goats in Rajshahi Goat Development Farm during the period from July 2010 to June 2011

SN Parameters	No. of kids	Birth weight (kg) Range	Mean ± SE	SN Parameters	No. (%) of kids	Birth weight (kg) Range	Mean ± SE
A. Parity (n)				B. Litter size			
1 (17)	19	1.2-1.5	1.30 ± 0.01	Single	027(11.54)	1.0-1.5	1.29 ± 0.02
2 (37)	93	1.0-1.5	1.28 ± 0.02	Twins	132(56.41)*	1.0-1.5	1.28 ± 0.01
3 (32)	65	1.0-1.5	1.27 ± 0.02	Triplets	063(26.92)	1.0-1.5	1.25 ± 0.02
4 (21)	34	1.0-1.5	1.27 ± 0.03	Quadruplets	012(05.13)	1.0-1.5	1.26 ± 0.05
5 (07)	14	1.0-1.5	1.28 ± 0.04	**Overall**	**234**	**1.0-1.5**	**1.27 ± 0.01**
6 (04)	09	1.0-1.5	1.16 ± 0.07				
Overall	**234**	**1.0-1.5**	**1.27 ± 0.01**	D. Season of birth			
C. Gender of kids				Rainy	94	1.0-1.5	1.27 ± 0.02
Male	111	1.0-1.5	1.38 ± 0.01	Winter	70	1.0-1.5	1.27 ± 0.02
Female	123	1.0-1.5	1.17 ± 0.01	Summer	70	1.0-1.5	1.28 ± 0.02
Overall	**234**	**1.0-1.5**	**1.27 ± 0.01**	**Overall**	**234**	**1.0-1.5**	**1.27 ± 0.01**

*t value 85.98 Significant at ($p < 0.0001$)

Kids survived and mortality

The kid is usually considered up to weaning age and kid mortality is a major factor determining the productivity of the goat flock. The kids survived and mortality rates are presented in Table 2. This study recorded an average of 8.12% kid mortality with highest

prevalence during winter (10.0%), followed by rainy (8.51%) and lowest during summer (5.71%) seasons (Table 2). The comparatively higher kid mortality rates of 20.5%[10] and 15.0%[25,26*] have been reported in BBG. However, the high kid mortality rate of 35% at low level of feeding had possible to reduce to 6.5% at high level of feeding of dam during gestation period in BBG.[23] The difference of kid mortality reported by different reports might be due to different management of the dams and their kids. However, the kid mortality may be associated with many factors like effect of dam weight at kidding, birth weight of kid, dam's milk yield, kidding season, litter size, parity, dam's nutrition and disease.[23]

The extensive system of rearing in which goats are allowed to browse and graze large areas of land that are marginal in nature and/or not suitable for other agricultural purposes and leaving them there for the whole season. Semi-intensive system of rearing is an intermediate compromise between extensive and intensive system followed in some flocks having limited grazing with supplement diet. When animals are continuously reared under housing of confinement in pen or shed and they are fed inside the shed (zero grazing system) is considered intensive system of raising goats.

The productive and reproductive performances like early maturity (puberty), larger litter size, shorter post-partum period, minimum kidding interval have been reported better in BBG in comparison to crossbred goats,[33] even its ranked higher in BBG than Jamunapari goat in semi-intensive management. However, the productive and reproductive performances of BBG could be improved through proper feeding and better husbandry practices.[4] Considering the socio-economic and climatic condition of Bangladesh, rearing of BBG under semi-intensive system would be more suitable than Jamunapari goats.[19]

Types of kid borne

Types of kid borne were found significantly (p < 0.0001) highest percentage of twin kids (56.41%) in comparison to triplets (26.92%), single (11.54%) and quadruplets (05.13%) kids (Table 3). These findings are in supports with the earlier reports of 41.04% twin, 25.37% triplet, 20.15% single and 13.43% quadruplet kids,[22] 66.76% twin, 27.55% single and 5.68% triplet kids[38] and 52.57% twin, 29.89% triple and 17.52% single kids[39] in BBG.

Kid birth weight

The overall birth weight of both the male and female kids ranged from 1.0 to 1.5 kg with an average of 1.27 kg and it was found higher in male (1.38 ± 0.01) than female (1.17 ± 0.01) kids of BBG (Table 3). This result on higher birth weight in male than female kids supports the earlier reports of 1.14 kg in male and 1.06 kg in female kids,[8] 1.38 kg in male and 1.23 kg in female kids,[31] 1.3 kg in male and 1.2 kg in female kids,[40] 1.08 kg in male and 1.04 kg in female kids[11] and 1.25 kg in male and 1.13 kg in female kids.[12] However, comparatively both the higher average birth weight of 1.6 kg,[21] 1.31 kg,[4,9,35] and lower birth weight of 0.75 kg,[32] 0.80 kg,[10] 0.93 kg,[7] 0.89 kg,[6] 1.24 kg,[39] 0.96 kg[19] have also been reported.

The birth weight of kids in the same breed of goat might be varied due to season of the year, type of birth, parity, age and weight of dam at kidding, nutrition, management and health and buck used for service.[4] The heavier birth weight recorded at the GGDF indicates better

environment and management that have some positive effect on weaned kid production by reducing kid morbidity and mortality and increasing the kid growth rate under semi-intensive management of goats.

CONCLUSIONS

Goats are probably the most well-adapted farm animals and due to its cheap management and good meat and milk production, goats have been considered one of the ancient animals to be domesticated all over the world. The higher prolificacy and fertility, lower maturity age, non-seasonality and relatively shorter kidding interval are the prominent beneficial traits for BBG. These results would provide an important perspective on the selection objectives of BBG and the evaluation of productive and reproductive traits is usually aimed at increasing meat, milk and progeny of BBG. Government programs to support goat rearing at rural areas should focus on research and training on genetic improvement through planned breeding and selection, farm management, infectious and parasitic disease control, product collection and marketing markets of goats and goat products.

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CONFLICT OF INTEREST

None to declare

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