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Article

Reproductive performance of Black Bengal goat under semi-intensive and extensive condition in Rajshahi district of Bangladesh

Md. Jahid Hasan*, Jalal Uddin Ahmed, Md. Mahmudul Alam, Mohammad Liaquat Osman Mojumder and Md. Showkat Ali

Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

*Corresponding author: Md. Jahid Hasan, Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. E-mail: jahidvet@yahoo.com

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Abstract: The present study was carried out to investigate the status of different reproductive parameters of Black Bengal in a rural area of Mukterpur under Charghat Upazilla of Rajshahi district during the period of July to December/2012. A total of 200 Black Bengal goats under both semi-intensive (n=100) and extensive condition (n=100) were selected on the basis of age, weight, body shape and conformation. The average age at puberty was 197.82±12.58 days and age at first conception was 292.96±0.50 days under semi-intensive condition whereas 208.82±12.60 days and 287.65±0.52 days under extensive condition. Age at first kidding was 448.26±25.48 days under semi-intensive condition whereas under extensive condition it was 450.07±22.43 days. Average litter size in the first, second and third parity was 1.06, 1.76 and 1.96, respectively under semi-intensive condition whereas under extensive condition, these were 1.01, 1.76 and 1.96, respectively. The average kidding interval of goats under semi-intensive and extensive conditions were 190.2±20 and 178.23±.50 days, respectively and the difference between these two was statistically significant (p<0.01). Sex ratio of male and female kids born was found to be 56 : 44, 44 : 56 and 55 : 45 in the first, second and third parity, respectively under semi-intensive condition whereas, it was 55 : 45, 48 : 52 and 54 : 56 in the first, second and third parity, respectively under extensive condition. The usual numbers of kids at one time in Black Bengal goats varied from single to quadruplet. Average post partum weight of does was higher under semi-intensive condition than extensive condition which was statistically significant (p<0.05). Age of kid mortality was more in first parity under one month of age but gradually decreased with the age of kids under both semi-intensive condition and extensive condition. The average birth weight of kids was 1.28 ± 0.11 kg and 1.25 ± 0.10 kg under semi-intensive and extensive condition respectively which was statistically significant (p<0.01). Average birth weight of male was higher than female under both conditions. Kid mortality increased from 2 to 21% with the increase of parity. Birth weight of kids was higher in July-October and kid mortality was higher in winter season. The age at puberty was found earlier in summer season than others seasons under both semi-intensive and extensive conditions. Reproductive performances of Black Bengal goat were better in third parity than that of the first and second parity under both conditions.

Keywords: goat; reproductive performance; semi-intensive condition; extensive condition

1. Introduction

Black Bengal is a promising dwarf goat breed known to be famous for its high adaptability, fertility, prolificacy, delicious meat and superior skin (Devendra and Burns, 1983; Husain *et al.*, 1996). The higher demand of meat and skin in the local as well as foreign markets focused the goat enterprise extremely prominent to the vulnerable group of people in the existing socio-economic condition of the country (Husain, 1993). However, goat productions in tropical countries are extensive, semi-intensive, tethering, intensive and integration into

crop. Semi-intensive production represents between extensive and intensive production and largely depends on the availability of land (Devendra and Burns, 1982). This system is popular where labour is limited for intensive agriculture. The greatest advantages of this method is effective conversion of crop residues, control of goats and little damage to the environment, and cheap labour for maintenance of goat (Devendra and Burns, 1982). Organized stall feeding is practically absent but during adverse climatic conditions farmers keep their goats in stall and feed with tree leaves, natural grasses and kitchen wastes (Husain, 1993).

Goats are regarded as an intimate and integral part of rural farming systems in Bangladesh. Many of the landless and marginal farmers own 1-5 goats and contribute economically to the subsistence farmers in mixed farming systems (Husain, 1993). There is a old saying that "*the goat is the poor man's cow*" is still hold true for developing country such as Bangladesh. While dairy cattle and poultry industry are making significant impact as a provider of animal protein in the country, small ruminants, especially goats have become very important in rural economy and nutrition throughout the country. Goat is now considered as the most promising livestock species for commercial meat (chevon) production.

Rajshahi district is a good place for rearing Black Bengal goat due to good climatic condition and have enough free area for grazing. There are lots of Jackfruit, mango, jiga, banana, guava and bamboo leaves for stall feeding. Native grass (*Axonopus comressium* and *Paspalum conjugatum*) available everywhere for grazing. So more or less every family rearing Black Bengal goat which makes economically independent. It is imperative to know the reproductive parameters of the Black Bengal goat in Bangladesh. There is limited previous report on the evaluation of reproductive parameters in Black Bengal in Bangladesh. Therefore, it seems rationale to investigate these parameters elaborately in Black Bengal goat resulting in increased productivity which will contribute in the diminution of poverty in the country. The present study was therefore undertaken to investigate the reproductive performances of Black Bengal goat under semi-intensive and extensive conditions in Rajshahi district.

2. Materials and Methods

2.1. Experiment site and period

The experiment was conducted in farmers' house at the village Mukterpur in Charghat upazilla under Rajshahi district. Mukterpur village is located about 35 km east-south from Rajshahi and by the side of Padma river. The experiment was performed from July 2012 to November 2012.

2.2. Selection of experimental goats

A total of 100 Black Bengal goats under semi-intensive condition from 22 farmers' house and 100 Black Bengal goats under extensive condition from another farmer's were selected on the basis of age, weight, body shape and conformation. Forty of them were pre-pubertal stage with age and weight around 10 months and 12 kg respectively and rest 60 were in first and second parity with around 16 months and 22 months old respectively under semi-intensive condition. For extensive study 45 of them were pre-pubertal stage with age and weight around 10 months and 12 kg respectively and rest 55 were in first and second parity with age around 16 months and 23 months old respectively.

2.3. Feeds and feeding

Under semi-intensive condition, feed were supplied twice daily at 8:30 am and at 4:30 pm. A concentrate mixture was provided at a rate of 300g/d for does and 100 g/d for kids. The does were allowed to graze from 9:00 am to 4:00 pm. Jackfruit tree leaves were provided in the farm yard. Under extensive condition, goats allowed to free grazing from 9:00 am to 5:00 pm. All the does were maintained with same feeds and feeding.

Under semi-intensive condition goats were given stall feed with Jackfruit tree leaves, Wheat bran, Matikali bran etc. Common grasses were feeding under both semi-intensive and extensive conditions. The plan of feeding was maintained according to the following Table 1.

Table 1. Roughage and concentrate feeding.

Ingredients	Feeding system	Amount (%)
Roughage		**75**
Common grasses	Pasture land	80
Jackfruit tree leaves	Cut and carry	20
Concentrate		**25**
Wheat bran	Stall feeding	60
Matikali bran	Stall feeding	40

2.4. Rearing systems

Rearing of goats under semi-intensive condition is widely practiced by small and marginal poor farmers. Most of the times goats were suited even at the time of grazing. Sometimes goats were unsuited at day times. In this system, animals go about looking for food and water. Animals graze on public pasture and in the night they are kept in fenced shelter. This system is inexpensive and requires minimal human supervision.

During the dry season, when grasses and plants disappear and water becomes scarce, many herdsmen join together and migrate to another area in search of pasture and water. This is an indigenous knowledge of goat farming. In the extensive system, goats graze over large area of marginal lands which are unsuited. In this system little management is needed though they were allowed to roam feeding at day time. One can use a plot of land (preferably at the outskirt) to partition the land into two parts. One side for the female, the other side for the male. Then, one can sub-divide the pasture area into two, allowing goats to feed at a period on one side of the pasture area, and when that is exhausted, they will be allowed to go to the other side of the grazing land to feed, while the pasture on the first area grows up.

2.5. Housing

The goats were reared by women and children under semi-intensive condition. In majority of cases the flock size ranges from 1 to 4. The animals were mostly housed along with residential housing; houses are mostly kachha type with straw roof. Floor space was about 1.85 sq. m /doe and 2.3 sq. m /kid. Almost all the farmers used to graze their goats for feeding. Most of times the goats were unsuited. The house was well ventilated and kids were housed along with their mother in the platform up to weaning. Under extensive condition the goats were reared mostly by women. They were kept on the bamboo made tin slatted shed with earthen floor of platform housing system. The house was well ventilated and kids were housed with their mother and other goats in the platform. Floor space was about 235 sq. m for 100 goats in the platform. Goats were kept freely at night and also whole day. Fresh drinking water was made available in bucket at the time of drinking.

2.6. Health and sanitation

Cleaning and hygienic management was maintained regularly. The floor, stall, water trough, and feeder were cleaned every day. The feces were removed carefully. All the does were dewormed using Fenbendazol (Tab. Paraclear® Tecno drug, Bangladesh) at 1tab/50kg orally) prior to the commencement of the experiment which was prescribed by the veterinarian. Dams were vaccinated against PPR (Peste des petits Ruminants) using live attenuated vaccine (Livestock Research Institute (LRI), Bangladesh).

2.7. Methods of data collection

In order to make the data collection program successful, the investigator personally visited door to door to the selected villages of the study area. Direct interview method was used for collection of information. Information given by owners of goats was recorded on questionnaire (questionnaire not shown) for analysis.

2.8. Determination of reproductive parameters of goats

Puberty is generally defined as the point of sexual development at which the animal becomes capable of reproduction (first ovulation in the female and first spermatozoa in the ejaculate of the male), but animals are not yet fully sexually mature at this stage. The age at puberty was estimated as the age in days when does exhibited the sign of first estrus, by observing wagging tail, swelling and water discharge from the vulva, jumping tendency to others and barking. The body weight was measured in kg of the female were recorded properly.

Age at first kidding was estimated in days from the date of birth to the date of first kidding. This trait can be recorded easily in a farmer's flock. There was much variation among production systems and breeds for this trait (12–24 months). It is usually late in animals living in harsh environments.

Litter size calculated as the number of kids born per conception per doe. This is a combination of ovulation rate and embryo survival. LS varied between 1.08 and 1.75 with average of 1.38. Positive relationships between LS and age, and LS and parity have been noted.

Kidding interval is the number of days between successive parturitions. It is called kidding interval in does. Under normal circumstances (no drought), tropical goats should be kidding at least three times in 2 years. For this to be realized, kidding interval should not exceed 8 months (245 days). As the major component of parturition interval is post-partum interval (PPI), accelerated lambing or kidding revolves around manipulating PPI because a shorter PPI will result in a shorter parturition interval. Better nutrition and early weaning could impact this measure of reproductive performance.

Kid mortality was recorded after kidding to weaning. Most of the kids were dead at age under one month. In winter season kid mortality frequently increased than others seasons. In kids pneumonia and tetanus were more frequently occurred which caused kid mortality.

2.9. Data analysis

The collected data were analyzed into Microsoft Excel and Microsoft word for descriptive statistics. The values age at puberty, age at first conception, age at first kidding, birth weight of kids, litter size, kidding interval, birth type at first and second parity, Sex ratios of kids, post partum weight of does, mortality rate of kids, age of death of kids, effect of season on different reproductive parameters were analyzed using descriptive statistics like mean, percentage, ratios and ranking.

3. Results and Discussion

The experiment was conducted to evaluate reproductive performances of Black Bengal goat available at Mukterpur in Charghat upazilla under Rajshahi district. Since most of the farmers do not keep proper records of their operation, in this study like other survey works, information from individual farmers was collected.

The traits considered for the assessment of reproductive performances of does are age at puberty, age at first conception, age at first kidding, birth weight of kids, litter size, kidding interval, birth type at first and second parity, sex ratios of kids, post partum weight of does, mortality rate of kids, age of kid mortality, effect of season on different reproductive parameters.

Table 2. Effects of rearing system on reproductive parameters of Black Bengal goat.

Parameters	**Semi-intensive condition (mean±SE)**	**Extensive condition (mean±SE)**
Age at puberty (d)	197.82±12.58	208.82±12.60
Age at first conception (d)	292.96±0.50	287.65±0.52
Age at first kidding(d)	448.26±25.48	450.07±22.43*
Litter size	1.06±0.13	1.01±0.10*
Kidding interval (d)	190.2±0.20	178.23±0.50*
Post partum weight of does (kg)	18.3±0.54	16.2±0.50*
Kid mortality (%)	15.0±0.50	10.07±0.32*

* = Significant; SE = Standard Error

Table 3. Litter size at different parity.

Parity	**Litter size (no.)**	
	Semi-intensive condition (mean±SE)	**Extensive condition (mean±SE)**
First	1.06±0.13	1.01±0.10
Second	1.76±0.12	1.62±0.12
	1.96±0.12	1.75±0.11
Overall	1.60±0.06	1.46±0.05

SE = Standard Error

Table 4. Birth weight / growth performance of kids at first and second parity.

Parameters	**Litter size**	**Sex**	**Parity**		**Level of significance**
			First parity (mean±SE)	Second parity (mean±SE)	
Birth weight (kg)	Single	M (single)	1.86±0.02	1.66±0.09	*
		F (single)	1.57±0.10	1.42±0.40	*
	Twin	M + F	1.72±0.01	1.52±0.81	*
	Triplet	M	1.41±0.02	1.28±0.18	*
		F	1.34±0.18	1.23±0.20	*
	Multifarious	M	1.18±0.02	1.09±0.10	*
		F	1.06±0.02	0.96±0.20	*

M= Male F= Female *= Significant (p<0.05) SE= Standard error

Table 5. Birth type at 1st and 2nd parity.

Parity	**Semi-intensive condition**			**Extensive condition**		
	Single %	Twin %	Triplet %	Single %	Twin %	Triplet %
First	90	10	0	85	15	0
Second	0	90	10	5	80	15

Table 6. Sex ratios of kids.

Parameter	**Semi-intensive condition**		**Extensive condition**	
	Male	Female	Male	Female
First parity	56	44	55	45
Second parity	44	56	48	52
Third parity	55	45	54	46

Table 7. Abortion rate of does.

Parity no.	**Abortion percentage**	
	Semi-intensive condition	Extensive condition
First	12	14
Second	1	3
Third	0	1
Fourth	0	0

Table 8. Kid mortality rate at different parities.

Parameters	Type of kids	Semi-intensive condition		Extensive condition	
		First parity	Second parity	First parity	Second parity
Kid mortality (%)	Single	5	21	0	10
	Twin	5	15	2	11
	Triplet	7	18	3	18

Table 9. Age of kid mortality.

Age (month)	Semi-intensive condition	Extensive condition
< 1	12	13
1-2	5	4
2-3	4	7
3-4	5	5
4-5	2	2

Table 10. Effect of season on reproductive performance of Black Bengal goat.

Parameters	Season-1	Season-2	Season-3	Probability
	Mean ± SE	Mean ± SE	Mean ± SE	
Birth weight (kg) of kids	1.36±0.1	1.38±0.18	1.15±0.14	NS
Litter size	1.37±0.11	1±0.23	1±0.17	NS
Age at puberty (d)	152.29±12.16	216.16±21.75	193.2±16.85	$p<0.01$
Age at first kidding (d)	331.41±24.63	368.33±44.07	365.4±34.14	NS
Weight at first kidding (kg)	18.27±0.53	15.16±0.96	16.32±0.74	$p<0.01$
Kid mortality (%)	5	5	10	NS

NS= Not Significant Season-1=March to June; Season-2 = July to October; Season-3 = November to February; SE= Standard error

The age at puberty was found 197.82±12.58 days under semi-intensive condition and 208.82±12.60 days under extensive condition (Table 2). This result was in agreement with the result of Hassan *et al.* (2007) who reported that average age at puberty in Black Bengal goats was 196.5±7.5 days. The present results also similar with the results of Banerjee (2004), who reported that age at puberty in Black Bengal goats was 200 days. Amin *et al* (2001) found the age at puberty of Black Bengal goat as 250 days reared under farmer's condition. Somewhat variation occurs due to various causes like presence of buck in the herd, plan of nutrition, availability of forages and temperature (Devendra and Burns, 1983). The age at puberty of Black Bengal goats was lower under semi-intensive condition than extensive condition may be due to more nutritive stall feeding and seasonal effect. Average age at first conception was average 292.96±0.50 days under semi-intensive condition and 287.65±0.52 days under extensive condition (Table 2). Genetic group and birth weight had significant effect, while litter size at birth and season of birth had non-significant effect on these traits. Black Bengal goats have significantly lower age at first conception and age at first kidding (Amit *et al.*, 2011). Average age at first conception was more under semi-intensive condition may due to more stressing condition and lower heat detection. In the present study the average age at first kidding was 448.26±25.48 days under semi-intensive condition and 450.07±22.43 days under extensive condition (Table 2). Chowdhury *et al.* (2002) observed the average age at first kidding of Black Bengal goat under semi intensive system 405 days. Somewhat variation with Hassan *et al.* (2007), who reported that average age at first kidding in Black Bengal goats, was 360.5±10 days. Epstein and Hertz (1964) reported that average age at first kidding depend on photoperiod, kidding season, nutritional status. Under semi-intensive condition age of first kidding was lower; it may be due to more concentrate feeding and also good manage mental system. The birth weights of kids at first parity were significantly ($p<0.05$) heavier than the kids at second parity.

The male kids were about 16% heaver at birth than the female kids in both parities. The birth weight of kids was heavier (1.86±0.02 kg) under semi-intensive condition than extensive condition (1.66±0.09 kg) may due to more body weight of does and also more nutritive feeding (Table 4). Mia *et al.* (1993) reported the birth weight of Black Bengal was 1.35 kg. Husain (1993) found average birth weight of Black Bengal kids were 1.03 and 0.93 kg for male and female respectively in Bangladesh. Relatively higher birth weights of male kids were observed in Black Bengal goat (Hussain, 1999; Chowdhury *et al*., 2002). Bobhate *et al*. (2003) reported that male kids had higher birth weight than females. Kids born in October-January had higher birth weight than in other seasons. Single born kids had higher birth weight than in twins and triplets. Genetic group, sex of kids, seasons of birth, type of birth and year of birth had significant effect on birth weight (Bobhate *et al*., 2003). Both male and female kids were heavier under semi-intensive and extensive condition due to more nutritive feeding. The birth weights of kids at first parity was heavier may due to more single type kids born than twin or triplet under both semi-intensive and extensive conditions.

Average litter size in first parity was 1.06±0.13 and 1.01±0.10 under semi-intensive and extensive condition, respectively (Table 3). Overall 1.60±0.06 kg and 1.46±0.05 kg semi-intensive and extensive condition, respectively (Table 3). The average number of kid born per kidding increased significantly ($P<0.05$) from first parity up to third parity under semi-intensive and extensive condition. This result was in agreement with the result of Chowdhury e*t al.* (2002) who reported that up to third parity, number of kids born increased linearly ($r^2=0.91$, $p<0.01$) from 1.08 to 1.96 kids. Litter size was affected by nutrient level, body weight parity, age and genetic factors.

The average number of kid born per kidding increased significantly ($p<0.05$) from first parity up to third parity under semi-intensive and extensive condition. It may be due to increased body weight of does. In the first parity, single kid comprised 90% and 10% twin under semi-intensive condition and 85% single and 15% twin under extensive condition (Table 5). In second parity twin and triplet type birth were 90% and 10%, under semi-intensive condition and 85% and 15% under extensive condition, respectively (Table 5). This result was almost similar to Chowdhury e*t al* (2002). They found from second parity onward multiple births consist of 64 and 80%, respectively. This agrees with the observation of high multiple birth of Black Bengal goat of 80-87%. Hassan *et al.* (2007) reported that the usual number of kids at one time in Black Bengal goat vary from single to quadruplet of which twin was most frequent (56.32%) and quadruplet was the least frequent (2.11%) litter size. In the present study, 90% single and 10 % twin kids were born and there was no triplets under semi-intensive condition. On the other hand 85% single and 15% twin kids were born and there were no triplets under extensive condition. Beside this, 90% twins and 10% triplets were born in the second parity but there was no single was born under semi-intensive condition, 5% single and 80% twin kids were born and 15% triplets under extensive condition. It was found from the present result that number of kid born was increased with parity due to higher body weight of does.

Average kidding interval in this study was 178.23±0.50 days under semi-intensive condition and 190.20±0.20 days under extensive condition (Table 2). This result was in agreement with the study of Shill *et al.* (2003) and Hassan *et al.* (2007). Hassan *et al.* (2007) reported that average kidding interval in Black Bengal goats was 179±10 days. This value is lower (220.55±2.88 days) observed by Husain (1993) for Black Bengal goats. In this trial the effects of parity, generation and parity × generation interaction on kidding interval was not significant ($p>0.05$). In the present study very short kidding interval of Black Bengal goat indicate the complete seasonality of estrus occurrence which ultimately allow them to produce kid twice in a year (Husain, 1993). Average kidding interval was lower under semi-intensive condition may due to more nutritive stall feeding.

The number of male kid in first and third parity was found higher with an exception of second parity. In first parity, the sex ratio of male and female kid was 56: 44 under semi-intensive condition and 55 : 45 under extensive condition (Table 6). Therefore, from the above results it may suggest that the variation of sex ratio was not due to breed of goat. Verma *et al*. (1991) found the sex ratio of male and female kid reported so far was 57: 43 in Black Bengal goat. These are similar with the results of 2nd parity and 3rd parity in the present findings, respectively.

The average doe weight after kidding was 18.3±0.54 kg under semi-intensive condition and 16.2±0.50 kg under extensive condition (Table 2). Loss of body weight after each kidding. Loss of body weight of does after each kidding under both conditions may be due to expulsion of kid(s) and also energy loss during the time of parturition. Chowdhury *et al*. (2002) reported that the effects of parity and generation on doe weight after kidding were significant ($p<0.01$) but the effect of generation × parity interaction was not significant ($p>0.05$). Kid mortality is highly correlated with the dam weight at kidding. Dam less than 10 kg body weight had kid

mortality of more than 87% which decreased ($\chi 2$ =37.56; P<0.01) exponentially with the increase in dam`s weight.

No abortion was found in third and fourth parity under semi-intensive condition (Table 7). This indicated that the increase of parity number had reduced the incidence of abortions. The abortion is higher under extensive condition than semi-intensive condition may be due to fighting between doe to doe or doe to buck/goat also stressing. Similar results reported earlier showed that fertility rate increases and abortion rate decreases with the increases of dam age (Mourand *et al*., 2000).

In this study, different parities had significant effect (p<0.05) on kid mortality. Mortality of kids was high in semi-intensive condition may be due to poisoning, higher diseases incidence and due to predator (Table 8). There was low mortality of kids under extensive condition where mortality of mainly due to fighting to each other's and also dam's low milk yield, low nutrition and disease of goats. One possible reason is that semi-intensive production system increases stresses on animal, to which they responded by higher diseases incidence and mortality. Ahmed (2006) found that Black Bengal had higher mortality rate (10.5%) at first generations. This might be due to the environmental factors and milk production. Overall kid mortality in this trial (about 30%) was much higher observed by Husain (1999) for Black Bengal goat kid maintained under farmer's condition.

Mortality of kids was high under one month in both semi-intensive and extensive conditions due to immune level and birth weight of kid (Table 9). Mortality was gradually decreased with the growth of kids under both conditions. Chowdhury *et al*. (2002) found kid mortality is responsible for many interacting factors, such as effect of dam weight at kidding, effect of birth weight of kid, effect of dam's milk yield, season, effect of birth, effect of litter size, effect of parity, effect of dam's nutrition and diseases were.

Effect of season on reproductive performances like birth weight of kids, age at first heat, weight at first kidding were suitable in July to October (Table 10). But kid mortality was more November to February i.e. in winter season (Table 10). Occurrence of diseases caused kids mortality was more by pneumonia but no death by pest des petits ruminant (PPR). Death by PPR is higher in does than kids. Pneumonia, tetanus, skin diseases, conjunctivitis, enterotoxaemia/diarrhoea, ecthyma, bloat were also recorded in kids. Does are mostly affected and died with PPR. In an experiment Chowdhury *et al.* (2002) observed mortality rate was highest in kids (28.97%) followed by young goats (22%) and adult (11.78%). Incidence of diseases were the highest during hot and wet (July to October) followed by hot and dry season (March-June). Most of the adult mortality was due to enterotoxaemia and kid mortality due to infectious causes like diarrhoea and pneumonia. These higher mortality in semi-intensive rearing systems possibly due to increased stresses on animal, to which they responded by higher diseases incidence and mortality.

4. Conclusions

From this study it can be concluded that rearing extensively with improved feeding and better management practices may help in higher reproductive and productive performances of Black Bengal goats that would be profitable for goat rearing at rural areas in Bangladesh.

Conflict of interest

None to declare.

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