

## Rearing Black Bengal Goat under Semi-Intensive Management

### 1. Physiological and Reproductive Performances

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**ABSTRACT :** Ninety pre-puberal (6-7 months) female and 15 pre-puberal male Black Bengal goats were collected on the basis of their phenotypic characteristics from different parts of Bangladesh. Goats were reared under semi-intensive management, in permanent house. The animals were vaccinated against Peste Des Petits Ruminants (PPR), drenched with anthelmintics and deeped in 0.5% Melathion solution. They were allowed to graze 6-7 h along with supplemental concentrate and green forages. Concentrates were supplied either 200-300 g/d (low level feeding) or quantity that supply NRC (1981) recommended nutrient (high level of feeding). Different physiological, productive and reproductive characteristics of the breed were recorded. At noon (temperature=95°F and light intensity=60480 LUX) rectal temperature and respiration rate of adult male and female increased from 100.8 to 104.8°F and 35 to 115 breath/min, indicated a heat stress situation. Young female attain puberty at an average age and weight of 7.2±0.18 months and 8.89±0.33 kg respectively. Mean age and weight at 1st kidding were 13.5±0.49 months and 15.3±0.44 kg respectively. It required 1.24-1.68 services per conception with an average gestation length of 146 days. At low level of feeding the postpartum estrus interval was 37±2.6 days, which reduced ( $p<0.05$ ) with high feeding level to 21±6.9 days. Kidding interval also reduced ( $p<0.05$ ) from 192 d at low feeding level to 177 d at high feeding level. On an average there were two kiddings/doe/year. Average litter sizes in the 1st, 2nd, 3rd and 4th parity were 1.29, 1.71, 1.87 and 2.17 respectively. Birth weights of male and female kids were 1.24 and 1.20 kg respectively, which increased ( $p<0.05$ ) with better feeding. Although kid mortality was affected ( $p<0.05$ ) by dam's weight at kidding, birth weight of kid, milk yield of dam, parity of kidding, season of birth, but pre-natal dam's nutrition found to be the most important factor. Kid mortality reduced from 35% at low level of feeding to 6.5% at high level of feeding of dam during gestation. Apparently, this was due to high ( $p<0.05$ ) average daily milk yield (334 vs. 556 g/d) and heavier and stronger kid at birth at high feeding level. (*Asian-Aust. J. Anim. Sci.* 2002, Vol 15, No. 4 : 477-484)

**Key Words :** Black Bengal Goat, Reproduction, Feeding and Kid Mortality

#### INTRODUCTION

Presently goat (677 millions) is the fourth largest livestock groups in the world (Morand-Fehr and Boyazoglu, 1999). At world scale, goat population has increased by 2.9% which is of a much higher rate than sheep (-1.8%) and cattle and buffalo (0.5%) (Peters, 1999). In Asia, however, the growth rate of the population of small ruminants (sheep and goat) is much higher (5.3 vs. 1.8%) than the large ruminants (cattle and buffalo). There are approximately 20 millions goats in Bangladesh (Honhold, 2001) with an annual growth rate of goat population is 2.5%, which is close to the population growth of human. This is probably due to the fact that keeping small ruminants has multiple benefits, e.g., require small area, they are a reliable producer in bad time, a prolific breeder, lower nutritional requirement compared to that of cattle and buffalo, highly selective feeding habit and therefore a broader feed range, as asset that can be liquidated for finance in times of need, as meat animal with a convenient size to slaughter for social and religious celebration. The correlations between the

number of goat per inhabitant and the mean income of the population -0.77 and -0.52 (Morand-Fehr and Boyazoglu, 1999), clearly suggest that the old saying of "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, specially 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 second only to the poultry in the country. Many of the rural land-less and marginal farmers own 1-5 goats. These goat farmers are distributed throughout the country, and are economically viable households in mixed farming systems. They keep other livestock and produce crops. In some areas, goats contribute up to 41% of the total income of the farm (Husain, 1993). Most of the goats (90%) in the country are Black Bengal (Amin et al., 2001), reputed for their : high prolificacy, high fertility, early sexual maturity, adaptability to hot humid conditions and superior quality meat and skin (Devendra and Burns, 1983; Husain et al., 1996, 1998; Anun et al., 2001). However, Black Bengal goats are reported to be slower in growth, low producer of milk, higher kid mortality (Devendra and Burns, 1983; Husain et al., 1996, 1998; Anun et al., 2000, 2001;

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Honhold, 2001). Most of these observations are based on data from goats reared under subsistence farming where environmental conditions (nutrition in particular) are not always conducive to express genetic potentiality of these animals. None can be sure about these limitations of Black Bengal goats whether they are of genetic or environmental nature. The present study was thus aimed at studying the physiological and reproductive performance of Black Bengal goat under semi-intensive management, where goats are allowed to graze in well-grown pasture with adequate levels of concentrate supplementation.

## MATERIALS AND METHODS

### Location and agro-climate

The study was conducted at the Bangladesh Livestock Research Institute. The station is located at 23°53'N, 90°17'E at an altitude of 1 meter above the sea level. Agro-ecologically belongs to the Madhupur Tract (Agro Ecological Zone 28) of Bangladesh. Red-Brown Terrace strong acidic (pH 4.5-5.5) soil with very little (<1.5%) organic matter (Brammer et al., 1988). Mean annual temperature is 25.3°C but can be <15°C for 50-70 days (Dec.-Feb.), <20°C for 80-90 days (24th Nov.-18th Feb.) and >40°C for 0-0.5 day (during July). Total annual rainfall is about 2,000 mm during 5 months (Jun-Oct.) with mean rainfall of 200 mm.

### Season's description

In this study seasons were described as dry hot period (March to June), wet and hot period (July to October) and cold and dry period (November-February). Thermal humidity index (THI) was measured as.

$$\text{THI} = \text{Temperature of dry bulb (}^\circ\text{C)} + (0.36 \text{ temperature of dewpoint. }^\circ\text{C)} + 41.2^\circ\text{C}$$

### The experimental animals

Black Bengal goats of 90 does and 15 bucks were collected at pre-puberal stage from different parts (Mymensingh, Manikganj, Sirajgang, Rajbari, Dhaka, Noakhali and Faridpur) of Bangladesh on the basis of body type, conformation, and their ancestral history on production and reproduction. However, productive and reproductive performances were recorded on 67 selected Black Bengal does (foundation stock) and their progenies.

### Management of experimental animals

*Housing* : Goats were housed in a permanent concrete floor house. Sawdust (March-October) and rice straw (November-February) were used as bedding for adult animals. Bucks and bucklings were always kept separately from the does herd to avoid unplanned mating. Young kids

were kept in a specially designed wooden brooding pen with facilities for temperature control, feeding and watering provision and with adequate bedding materials. All goats were allowed to stay separately according to sex and age group in a fenced open run in front of the shed from 07:00 to 09:00 for heat detection and health care.

*Feeding* : Two levels of feeding were used for the goat during the trial period. Low plane of feeding continued from June, 99 to September 2000 and high plane of feeding was used from October 2000 to May 2001.

*Low plane of feeding* : Goats were allowed to graze from 09:00 to 4:30 with 1 h rest (1:00 to 2:00). Leucaena or Jackfruit leaves and cut and carry green grasses were also supplied *ad libitum* at night. A concentrate mixture (17% CP; 11 MJ ME/kg DM) was provided twice daily in the morning and evening at the rate of 200, 250 and 100 g/h/d respectively for bucks, does and growing kids.

*High plane of feeding* : Here grazing time was the same as for the low plane of feeding but the concentrate amount was increased to meet the NRC (1981) recommended quantity of metabolizable energy (ME) and digestible protein (DP) for different weight and physiological status. Concentrate mixture used contained 20% CP and 11.92 MJ ME/kg DM.

Kids had free access to their dams for the whole day except during the night (20:00 to 06:00). Besides, they were bottle-fed with goat milk. However, newly born kids were allowed to stay with their mother except the grazing time for the initial 7 days. On an average, kids received at least 200 g milk daily during the 1st month of their life.

*Breeding* : Selective breeding was performed to avoid possible inbreeding and obtain maximum genetic gain. Records were kept on different productive and reproductive characteristics.

*Physiological characteristics* : Physiological characteristics in terms of respiration (breath/min), rectal temperature in relation to age, sex, time of the day, ambient temperature and radiation level were measured once (during April, 2001) in the study period.

*Health* : Animals were dewormed immediately after collection and then regularly twice a year-prior to (April) and immediately after (November) the monsoon. They were vaccinated against PPR. Necessary treatments were provided against specific diseases according to the suggestion of Veterinarian. All animals were deeped in 0.5% Malathion solution in 7-20 days interval.

*Reproductive characteristics* : Reproductive characteristics e.g., age and weight at 1st heat, age and weight at 1st conception, service(s) per conception, gestation length, litter size and weight, postpartum estrus interval (PEI), kidding interval of female were recorded. Heat was detected from the physical signs of heat (braking, swelling and mucus discharge of vulva, jumping on other animal, off-

feed), which was then confirmed with a teased buck.

**Statistical analysis** : Data were analyzed by using univariate GLM procedure of SPSS 9.0 for Windows (SPSS Inc. 1998). The following statistical model measured the effect of parity and feeding level on different productive and reproductive parameters.

$$Y_{ij} = \mu + \alpha_i + e_{ij}$$

Here,  $\mu$  is the general mean,  $\alpha_i$  is the effect of either parity ( $i=1,2,3$ , or 4) or feeding level ( $i=1$  (low feeding level), 2 (high feeding level)), or season ( $i=1, 2$  or 3),  $e_{ij}$  is the random error. The Chi square test of fixed factor contingency table was used for analyzing the factors responsible for kid mortality; besides, linear, logarithmic or exponential models were used for expressing the relationship of two variables where appropriate.

## RESULTS AND DISCUSSION

### Physiological characteristics

Table 1 shows respiration and rectal temperature of Black Bengal goats of different age and sex groups along with the ambient temperature and radiation level at three different times of the day. With the increased ambient temperature and radiation level, both rectal temperature and respiration rate of Black Bengal goat increased during the noon and then decreased slightly during the afternoon. Increases in the ambient temperature from 86 to 95°F, the rectal temperature of buck increased from 100.8 to 104.8°F and the respiration increased from 35 to 115 breath/min. Similar phenomenon was also observed in lactating doe. During this accelerated respiration, animal breath fast and increases the dead space ventilation without increasing the alveolar ventilation called panting. However, the effect of ambient temperature and radiation level was more pronounced in the adult than the growing animals. This is probably indicating a heat stress situation in the adult

animals at least during the noon. Respiration is the main route of evaporative heat loss of goat through the respiratory tract (Gall, 1991). The above measurements were recorded during the dry hot months of the year with relatively lower thermal humidity index (THI) of 72 (Leng, 2001). While, during the wet and hot months, average THI is 75.8, which reduces the evaporative heat loss and make animal more heat stressed. Since sweating is not an important channel of heat loss in goat (Devendra and Burns, 1983), they can be expected to be in a more heat-stressed situation during July to October. Heat stress causes lower - feed intake, metabolic rate and activity that entails with lower productive and reproductive performances (Johnson, 1991). Thus management practices to cool goats together with feeding management to minimize metabolic heat production is essential during the hot months. Under heat stress situation, feeding should be aimed at increasing the ratio of protein : energy in the absorbed nutrient (Leng, 2001). This can be achieved by balancing the rumen and also by increasing the rumen undegradable protein supply in the diet.

### Reproductive Characteristics

Table 2 shows the reproductive characteristics of female Black Bengal goat. Age at 1st heat varied considerably between goats with a mean of 216 days (7.2 months), which is slightly lower than that of 250 days observed in Black Bengal goat, under subsistence rearing conditions (Amin et al., 2001). Live weight at puberty was also lower in this trial (8.89 kg) than that observed (9.73 kg) by Amin et al. (2001). Doe gave birth to their 1st kid at an average age of 13.5 months and live weight of 15.27 kg. Ali et al. (1973) reported that average age at 1<sup>st</sup> kidding for Black Bengal goat is 14 months, which is similar to our observation.

### Litter size

Litter size of Black Bengal goat studied ranged between

**Table 1.** Some physiological parameters of Black Bengal goat at different age and sex groups

Parameters	Castrated male (6-12 months)			Growing female (6-12 months)			Adult buck			Lactating doe		
	Morning	Noon	Afternoon	Morning	Noon	Afternoon	Morning	Noon	Afternoon	Morning	Noon	Afternoon
Mean respiration rate (breath/min)	39.8	47.3	49.8	41.3	64.9	53.5	30.9	114.7	62.1	53.9	104.1	71.0
SE	1.28	2.41	1.42	2.49	6.75	2.25	1.99	13.72	7.23	2.69	10.98	4.68
Mean rectal temperature (°F)	101.9	103.0	102.9	101.7	103.7	102.7	100.8	104.8	103.2	101.4	104.0	102.6
SE	0.16	0.24	0.23	0.19	0.38	0.29	0.13	0.28	0.18	0.10	0.15	0.11
Mean ambient temperature (°F)	86	95	90	86	95	90	86	95	90	86	95	90
Mean light intensity* (LUX)	486	60480	227	486	60480	227	486	60480	227	486	60480	227

Morning and afternoon light intensity were measured inside the goat house and noon light intensity was measured outside in the field. SE=Standard error.

**Table 2.** Reproductive traits of female Black Bengal goat under semi intensive management

Traits	No. of animals	Range	Mean±SE
Age at 1st heat (days)	32	131-338	216±9.52
Weight at 1st heat (kg)	19	6.8-11.0	8.89±0.33
Age at 1st service (months)	19	9.2-14.2	10.98±0.57
Age at 1st kidding (days)	9	273-500	405±25.48
Weight at 1st kidding (kg)	69	9.95-27.0	15.27±0.44

SE=standard error.

1-3. The average number of kid born per birth increased significantly ( $p<0.05$ ) from 1.29, in the 1st parity to 1.71, 1.87 and 2.17 in the 2nd, 3rd and 4th parity respectively (table 3). In the 1st parity, single kid comprised 72% of the total kids born. While in the 2nd, 3rd and 4th parity proportion of twin kids was about 61%. From 2nd parity onward multiple birth consists 60-88% of the kid born in 112 observations. This agrees with the observation of high multiple birth of Black Bengal goat that was 80% (Rahman et al., 1977) to 85% (Moulick et al., 1966). Up to 4th parity, number of kid born increased linearly ( $b=0.28$ ;  $r^2=0.97$ ;  $p<0.01$ ; figure 1) from 1.29 to 2.17 kids per birth. Average litter size for Black Bengal goat reported to be ranging from 1.4 (Devendra and Burns, 1983) to 2.15 (Amin et al., 2001), which confirms the reputation of Black Bengal goat for high fecundity.

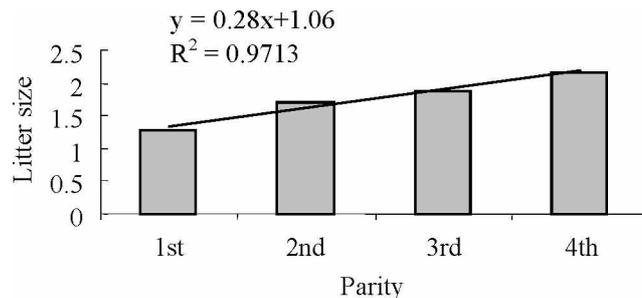
### Gestation length

Average gestation length of Black Bengal goat was 146, 147, 142 and 146 days respectively at 1st, 2nd, 3rd and 4th parity respectively (table 2). There was no significant effect of parity on gestation length. Although goat gestation period is fairly constant at around 146 days (Devendra and Burns, 1983), yet it may be affected by factors like season, year, sire (Gupta et al., 1964) kid birth weight and weight of dam at mating (Mishra et al., 1979). In this trial, gestation length was not affected ( $p>0.05$ ) by the season of birth which were 147.8 ( $\pm 3.08$ ), 142.8 ( $\pm 2.07$ ) and 146.3 ( $\pm 2.86$ ) respectively during hot and dry, hot and wet and cold and dry period of the year.

**Table 3.** Effect of parity on gestation length and litter size of Black Bengal goat under semi-intensive management

Parity	Number of observation	Gestation length (d)	SE	Litter size	SE
1 <sup>st</sup>	69	146	2.94	1.29 <sup>c</sup>	0.070
2 <sup>nd</sup>	55	147	3.12	1.71 <sup>b</sup>	0.079
3 <sup>rd</sup>	45	142	2.43	1.87 <sup>b</sup>	0.087
4 <sup>th</sup>	24	146	3.27	2.17 <sup>a</sup>	0.119

<sup>a,b,c</sup> Values with different superscripts in the same column differ significantly ( $p<0.05$ ). SE=standard error.

**Figure 1.** Effect of parity on litter size on average litter size of Black Bengal goat maintained under semi-intensive management.

### Post partum estrus interval

Interval from kidding to postpartum estrus interval (PPEI) ranged between 16-136 days with an average of 30 days. High feeding level significantly ( $p<0.05$ ) reduced the PPEI from 37.43 ( $\pm 2.61$ ) to 21.43 ( $\pm 6.87$ ) days (table 4). Post partum estrus interval was significantly ( $p<0.05$ ) higher in the 2nd parity than in the 1st, 3rd or 4th parity (table 5). The PPEI of Black Bengal goat reared under rural scavenging system reported to be 125 d for the 1st generation and 70 d for the 2nd generation (Amin et al., 2001). Higher PPEI in Black Bengal goat of 2.04 $\pm$ 1.76 months have also reported by Devendra and Burns (1983). Relatively shorter PPEI observed in the present trial indicate better ovarian activity in this herd. Apparently better nutrition was probably the most important contributing factor responsible for lowering the PPEI in this trial.

### Services per conception

Average number of services per conception were 1.45 and was not affected by the feeding level or parity (table 4 and 5). Service per conception was higher in this trial than that observed in Black Bengal goat of 1.22-1.10 under subsistence rearing (Amin et al., 2001).

### Kidding interval

Kidding interval ranged between 155-369 days with an average of 185 days. Kidding interval was significantly ( $p<0.05$ ) reduced from 192 days at low feeding level to 177 days at high feeding level (table 4). Parity, on the other hand, had no significant effect on kidding interval (table 5). Kidding interval observed in this trial was much shorter than many other reports. Hussain (1999) observed the kidding interval of Black Bengal goat ranged from 255-300 days reared under village conditions. Amin et al. (2001) also observed 211 days kidding interval for the same breed under subsistence rearing. Assuming average gestation length of 145 days, goat in the present study was opened only for 40 days and gave birth twice in a year. Open period for scavenging goat reared under traditional farming conditions were 110 days having only one kidding in a year

**Table 4.** Effect of feeding level on various productive and reproductive parameters of Black Bengal goat under semi-intensive management

Parameters	Low feeding*	SE	High feeding**	SE	Probability
Gestation length (d)	144 (73)	1.75	146 (35)	2.53	p=0.488
Post partum heat period (d)	37.43 (97)	2.61	21.43 (14)	6.87	p<0.05
Kidding interval (d)	192 (77)	3.85	177 (33)	5.88	p<0.05
Service per conception	1.49 (70)	0.087	1.31 (35)	0.124	p=0.260
Birth weight of male kid (kg)	1.20 (88)	0.032	1.46 (26)	0.059	p<0.001
Birth weight of female kid (kg)	1.20 (65)	0.102	1.27 (13)	0.227	p=0.808
Total litter production at birth (kg)	1.69 (152)	0.061	2.67 (24)	0.132	p<0.001
Total litter weight at weaning (90 d) (kg)	3.76 (152)	0.32	9.50 (24)	0.81	p<0.001
Kid (0-3 months) mortality (%)	35.2 (230)	-	6.5 (46)	-	p<0.01

\* Six hours grazing with 200 g concentrate as supplement. \*\* Feeding concentrate according to NRC (1981) recommendation. SE=Standard error. Values in the parentheses indicate the number of observation.

**Table 5.** Effect of parity on various productive and reproductive parameters of Black Bengal goat under semi-intensive management

Parameters	Parity								Probability
	1st	SE	2nd	SE	3rd	SE	4th	SE	
Post partum heat period (d)	31.17 <sup>b</sup> (23)	5.19	45.32 <sup>a</sup> (44)	3.76	30.19 <sup>b</sup> (32)	4.41	20.85 <sup>a</sup> (13)	6.92	p<0.01
Service per conception	1.61 (23)	0.150	1.68 (22)	0.153	1.28 (39)	0.115	1.24 (21)	0.157	p=0.07
Kidding interval (d)	-	-	191 (48)	4.89	191 (41)	5.29	172 (21)	7.40	p=0.09
Birth weight of male kid (kg)	1.14 <sup>c</sup> (39)	0.048	1.33 <sup>ab</sup> (32)	0.053	1.20 <sup>bc</sup> (27)	0.058	1.48 <sup>a</sup> (16)	0.075	p<0.05
Birth weight of female kid (kg)	1.05 (29)	0.151	1.40 (23)	0.170	1.16 (18)	0.192	1.38 (8)	0.288	p=0.43
Total litter production at birth (kg)	1.38 (69)	0.087	1.91 (55)	0.096	2.07 (45)	0.105	2.84 (24)	0.157	p<0.01
Total litter weight at weaning (90 d) (kg)	2.59 <sup>c</sup> (68)	0.484	4.39 <sup>b</sup> (52)	0.554	5.36 <sup>b</sup> (43)	0.609	9.13 <sup>a</sup> (18)	0.941	p<0.01
Kid (0-3 months) mortality (%)	50.00 <sup>a</sup> (80)	-	25.00 <sup>b</sup> (88)	-	26.76 <sup>b</sup> (71)	-	7.69 <sup>c</sup> (39)	-	p<0.01

<sup>a,b,c</sup> Values in the same row with different superscripts differ significantly. SE=Standard error.

Values in the parentheses indicate the number of observation.

Hussain (1999). This means that goat production in the country can be doubled by dietary intervention and the management followed in this study.

#### Kid birth weight

Birth weight of male and female kids was 1.24 ( $\pm 0.036$ ) kg and 1.19 ( $\pm 0.128$ ) kg respectively. Relatively higher birth weight of male kid has also been reported by many authors (Hussain, 1999; Amin et al. 2001). The litter type (table 6) did not affect birth weight of kid but birth weight of male kid was significantly ( $p < 0.05$ ) affected by the feeding level (table 4) and parity (table 5). One important feature is that average birth weight of both male and female kids was much higher in this trial than that observed by Hussain (1999) of 0.94 and 0.86 kg respectively. Birth weight is the main determinant of kid survival (Bajhau and Kennedy, 1990). Practical observation in our situation was

that kid less than 1 kg live weight is less likely to be survived. Birth weight is positively correlated with growth rate, adult size and kid viability (Devendra and Burns, 1983). Within-breed, variation in birth weight is partly genetic, but largely due to variation within the environment, especially nutrition and health (Devendra and Burns, 1983). Thus heavier birth weight observed in this trial indicate better environment, especially nutrition and health that will have positive effect on total weaned kid production by reducing the kid mortality and increasing the kid growth rate.

#### Seasonality of kidding

Of 191 kidding records, 40 (20.94%) was born during hot and dry months (March-June), 91 (47.64%) during hot and wet months (July to September) and 60 (31.41%) during cold and dry months (October to February). Amble

**Table 6.** Birth weight of kid of Black Bengal goat under semi-intensive management

Sex	Single	SE	Twin	SE	Triplet	SE	Probability
Female	1.51	0.127	1.31	0.144	1.09	0.333	p=0.657
Male	1.26	0.049	1.27	0.043	1.20	0.086	p=0.085
Over all	1.38	-	1.29	-	1.15	-	-

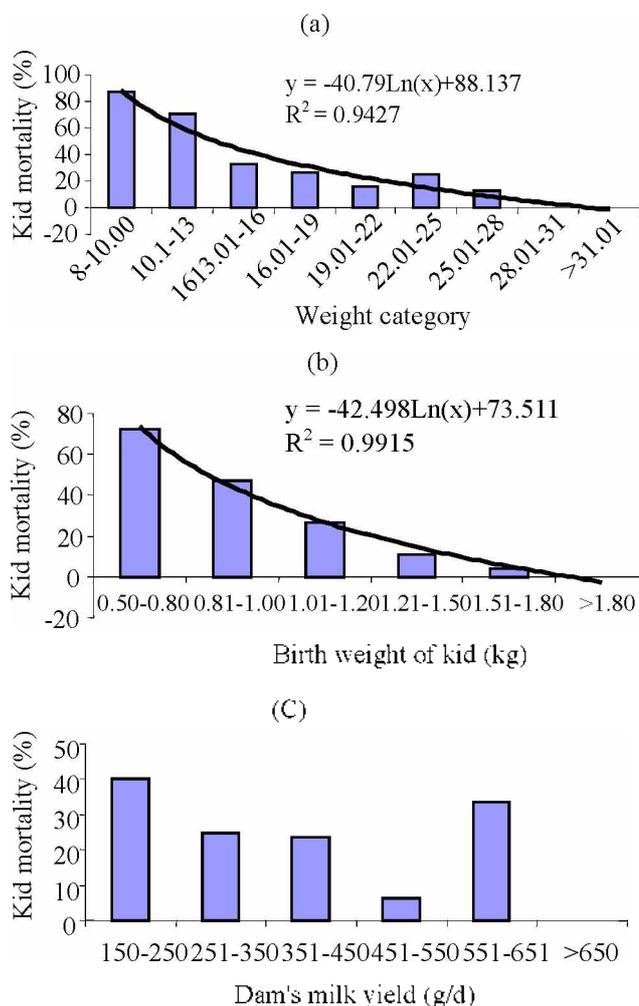
SE=Standard error.

et al. (1962) showed that peak incidence of kidding occurred from March to April and October-November in Jamnapari goat.

### Kid mortality

Neonatal mortality is a major factor determining the productivity of a herd and is also a sensitive index of management efficiency. Factors affected the kid (0-6 months) mortality are as follows.

1. Effect of dam weight at kidding: Weight of dam at kidding profoundly affected the kid mortality. Dams were categorized into weight groups as 8-10, 10.01-13, 13.01-16, 16.01-19, 19.01-22, 22.01-25, 25.01-28, 28.01-31 and >31kg each having 8, 17, 73, 56, 57, 44, 16, 4 and 1 observations respectively. 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 (figure 2).
2. Effect of birth weight of kid: Birth weight of kids were categorized as 0.5-0.8, 0.81-1.00, 1.01-1.20, 1.21-1.50, 1.51-1.80, >1.80 kg each having 29, 76, 67, 73, 26 and 3 kids respectively. Kids weighing less than 0.8 kg birth weight had mortality more than 70% which decreased ( $\chi^2=57.67$ ;  $p<0.01$ ) exponentially with the increase in kid birth weight (figure 2).
3. Effect of dam's milk yield: Dam's were categorized on the basis of their milk yield into 150-250, 251-350, 351-450, 451-550, 551-650 g milk/d each having 50, 44, 51, 32, 24 and 7 observations respectively. Kid mortality decreased ( $\chi^2=15.05$ ;  $p<0.01$ ) almost linearly from 40% at 150-250 g milk production daily to about 6% at 451-550 g milk yield daily (figure 2). However, kid mortality increased again at 551-650 g milk yield level probably due to indigestion and scouring resulting from overfeeding of milk. One possible reason could be that increased milk ingestion increases the amino acids absorption, which may results an elevated plasma amino acids concentration. In human subject, elevated plasma amino acids concentrations found to inhibit the pancreatic secretion (DiMagno et al., 1973). As a result, large amount of undigested or partially digested casein might have escaped enzymatic digestion and resulted scouring due to hind gut fermentation. However, such phenomenon was not observed at >650 g milk yield level.
4. Effect of birth season: Seasons were classified as hot



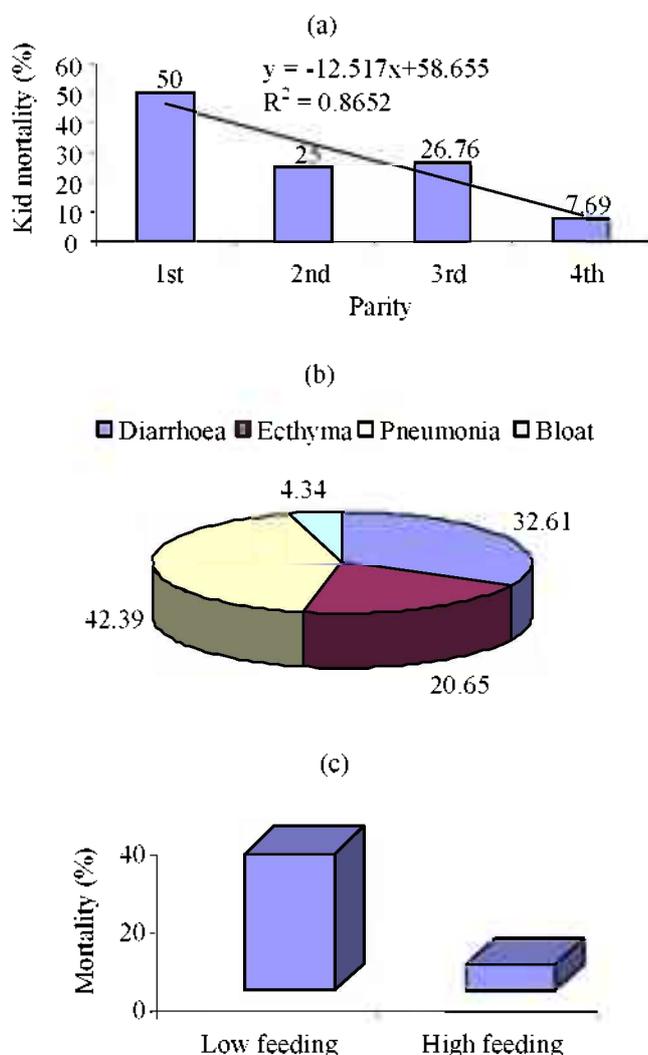
**Figure 2.** Effect of dam's weight at kidding (a), kid birth weight (b) and dam's milk yield (c) on kid mortality

and dry (March-June), hot and wet (July-October) and cold and dry (November- February) having 65, 127 and 86 birth records in each season respectively. Hot and wet period (40%) had significantly ( $\chi^2=14.22$ ;  $p<0.01$ ) higher kid mortality than hot and dry (15.38%) or cold and dry (24.42%) period.

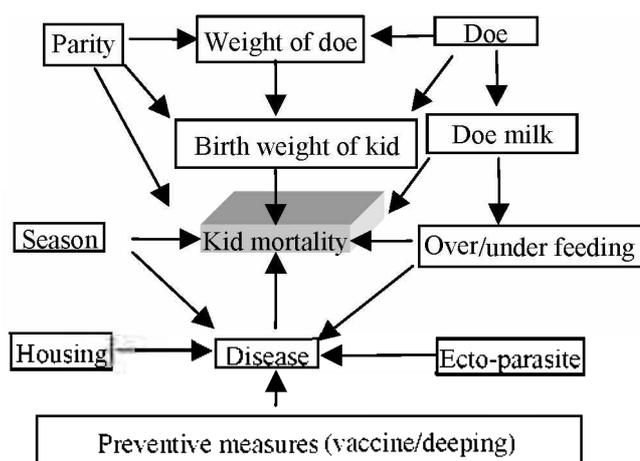
5. Effect of litter size: There were 78, 154 and 48 birth record of single, twin and triplet respectively. Surprisingly, there was no significant difference between single, twin or triplet kidding on kid mortality, which was 33, 28, and 31 per cent, respectively.
6. Effect of parity: There were 80, 88, 71 and 39 birth

records on 1st, 2nd, 3rd and 4th parity, respectively. Kid mortality decreased ( $\chi^2=25.79$ ;  $p<0.01$ ) linearly ( $b=-12.51$ ;  $r^2=0.87$ ;  $p<0.05$ ) with increase in parity number (figure 3). At 1st parity kid mortality was 50%, which reduced to 8% at the 4th parity.

7. Effect of dam's nutrition: There were 230 and 46 kids whose mothers were at low and high feeding level respectively. Dam's fed at high feeding level (6.52%) had significantly ( $\chi^2=14.91$ ;  $p<0.01$ ) lower kid mortality than those fed on low plane (35.22%) of nutrition (figure 3).
8. Effect of diseases: Of the 170 total dead kids, 92 (54.12%) died due to diseases, 48 (28.23%) due to low birth weight, 5 (2.94%) due to predator and 25 (14.7%) due to other reasons. Of the 92 dead cases, Pneumonia, and Diarrhoea accounted 42.39 and 32.61% of mortality ( $\chi^2=29.65$ ;  $p<0.01$ ) followed by Ecthyma (20.65%) and Bloat (4.34%) (see figure 3).



**Figure 3.** Kid mortality of Black Bengal kids as effected by the parity of kidding (a), type of diseases (b) and feeding level (c)



**Figure 4.** Factors affecting kid mortality of Black Bengal Goat under semi-intensive management

Overall kid mortality in this trial (about 30%) was much higher than only 5-12% mortality observed by Husain (1999) for Black Bengal goat kid maintained under farmer's condition. One possible reason is that semi-intensive production system increases stresses on animal, to which they responded by higher diseases incidence and mortality. However, household survey of Animal Health Research Division of the Bangladesh Livestock Research Institute showed a kid mortality (0-6 months) of 29.9% which were similar those for village goats in Nepal and Zimbabwe (Honhold, 2001). Kid mortality is an ultimate result of many interacting factors stated earlier. These interactions are shown in figure 4. However, improving pre-natal and post-natal maternal nutrition found to counteract with the stresses related mortality. Probable mechanism may be that better nutrition increases immune level and birth weight of kid, which in turn increased the kid survivability.

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