Chapter I: Introduction

The goats have been portrayed as poor man's cow in the developing country because of their enormous contribution to the poor man's rural economy (Dhakal et al., 2021). The goat not only supplies very high quality meat and milk but also earns round the year household income for underprivileged landless and marginal farmers. Hence, goats have been recognized as an integral component of the existing mixed farming systems to support the landless rural people. Being small in size, goats can freely be reared by the unemployed women and children. In Bangladesh, goat population is about 26.40 million in the year 2020-2021 of which 90% are native goat breed known as the Black Bengal goat (BBG) (DLS, 2020). The BBG is globally recognized for their prolificacy, fertility, early sexual maturity, better skin quality and very high adaptability to the hot-humid environment. The breed is found in almost everywhere of the country who graze mostly on barren road-side fallow lands with native grasses and least homestead supplies, i.e., rice gruel, kitchen wastes, fruit peels and tree leaves (Hossain, 2021).

Most of the smallholder farmers (80.5%) in Bangladesh rear goats in the semi-intensive system and only a few of them (7.3%) practice confinement while the rest of the farmers (12.2%) use free range system (Moni and Samad, 2019). The goat population is in increasing in the country due to involvement of government and non-government initiatives. Currently the contribution of the livestock sector to overall GDP is 1.44% (DLS, 2020). Hence, a major part of the animal protein can be met up from chevon if special priority can be given over the productivity of BBG. Additionally, rearing BBG could be modeled as an effective tool for poverty alleviation as it requires less investment and rearing cost. Considering above facts, Bangladesh Government has taken a national initiative on rearing of BBG to diminish the poverty of the nation. Hence, the BBG plays a significant role for poverty alleviation, income generation, food safety and employment generation of the nation. Systematic information regarding driving factors of the performance potentials of BBG under semi-intensive systems is scant. We, therefore, aimed to elucidate the determinants of the mature body weight of BBG under the semi-intensive system of rearing.

Chapter II: Materials and Methods

2.1. *Study area and agro-climate*

The study was conducted in the sadar upazila, Rangpur, Bangladesh. The climate of the study is classified as warm and temperate. The summers are much rainier than the winters. The soil composition is mainly alluvial (80%) of the Teesta River basin and the remaining is barren soil. The temperature ranges from 11-32 ºC and the annual rainfall averages 2931 mm.

2.2. *Study design*

A cross-sectional survey was conducted in the BBG households using a structured questionnaire for a period of three months from 1st February to 30 April, 2021.

2.3. *Household selection*

Total 50 households out 377 from Rangpur sadar upazila were selected. The households were interviewed by walking door to door from the entrance to the end of the village until the sample size was reached. A goat household was surveyed selected based on the following criteria: at least five year of experience for goat rearing, currently owning at least two adult wethers and one doe, free family labor and surrounding barren lands for grazing the goats (perceived from pilot study), no objection of the family members for goat keeping.

2.4. *Farmer's interview*

One interviewer (fourth year veterinary students from CVASU under supervision of CVASU academician) was trained in surveying and interviewing techniques at CVASU. Farmers were interviewed in their own premises. In order to get in depth, one interviewer interviewed only two farmers per day. It took around two hours to interview a respondent. A break of 30 minutes was taken between two subsequent interviews. An observation list was also completed during the farm visit. Institutional approval for conducting interviews with the BBG households was obtained from CVASU.

2.5. *Data collection*

Before, the field survey, a structured questionnaire (Appendix I) and a survey protocol were developed to achieve targeted objectives for the BBG. After briefing the objectives of the interview, verbal and written consents of the respondents were taken. At least one week before interview, the interviewer was given printed materials as guidelines for the survey. The interviewer was further trained up during the pilot testing by the senior faculty member. The questionnaire was pre-tested on 5% of BBG households. Unwanted, ambiguous and long questions were eliminated through pilot-testing. Finally, comments and suggestions made by the respondents were incorporated to improve and update the questionnaire under the field conditions. The questionnaire included observational checklist, socio-economic status of the interviewee, herd structure, demography, housing systems, feeding system, reasons of BBG rearing, immunization, health, formulation and purchase of BBG feed, farmers need and threats of BBG rearing. Many of the farmers replied the questions of interviewer in colloquial language. As a result, audio recorder and head note were used to record the information during each interview.

2.6. *Statistical analysis*

Raw data were compiled into Microsoft excel professional 2020 (Microsoft corporation, USA). Outliers and multicolliniarity in the data set were tested by inter quartile range test and variance inflation factors. Normality of the response variable was checked by Shapiro Wilk test. Profile plots were used to measure the interactions of the covariates. The data were analyzed by generalized linear model (GLM). Kaiser-Meyer-Olkin measures of sampling adequacy and Bartlett's test of sphericity were applied to test the suitability of the dataset for the principal component analysis (PCA). Heatmap of multiple orthogonal contrasts were produced to check the latent trends, dimensionality and strengths of the co-variates. Based on maximum 'eigen' values, the test variables were standardized and contrasted against two PCA components labeled on 'x' and 'y' axes. When statistical effects were deemed significant ($p<0.05$), the Duncan's New Multiple Range Test (DMRT) was used to compare the means. All statistical tests were performed by using Stata 14.1 SE (Stata Corp LP, College Station, Texas, USA). The following statistical model was used:

$Y_{ijklmno} = \mu_i + A_{ij} + B_{ik} + C_{il} + \ldots\ldots N_{in} + e_{ijklmno}$

Where,

$Y_{ijklmno}$	=	The observed effects of the trait 'i' for the 'j^{th}' genotype, 'k^{th}' parity, 'l^{th}' season, 'm^{th}' dry period, 'n^{th}' postpartum period and 'o^{th}' calving interval;
μ_i	=	The intercept of the regression model for the trait 'i';
A_{ij}	=	The fixed effects of the 'j^{th}' factor 'A' for the trait 'i' (j=1,2, …n);
B_{ik}	=	The fixed effects of the 'k^{th}' factor 'B' for the trait 'i' (k=1,2, …n);
C_{il}	=	The fixed effects of the 'l^{th}' factor 'C' for the trait 'i' (l=1,2, …n);
N_{in}	=	The fixed effects of the 'n^{th}' factor 'N'for the trait 'i' (n=1,2,…n);
$e_{ijklmno}$	=	The random sampling error of the trait 'i' for the 'j^{th}' factor 'A', 'k^{th}' factor 'B', 'l^{th}' factor 'C' and 'n^{th}' factor 'N' distributed as $\varepsilon_i \sim NID(0,\sigma^2)$.

Chapter III: Results

3.1. *Herd structure, housing and feeding*

The average herd size of BBG reared under semi-intensive system was 8.08. Houses were mostly open type, tin-shed, bamboo and wood supported earthen floor with facilities for night shelter and feed supply and in very few cases brick-cemented with concrete floor. Feeding system was open grazing with variable amount of homemade concentrate mixture (Table 1).

3.2. *Performance parameter*

The mature body weight, body condition score and daily milk yield of the Black Bengal doe under semi-intensive farming system were 22.9 kg, 3.4 and 0.5 kg respectively (Table 1).

3.3. *Reproductive parameter*

The age at the first service of the BBG was 22.14 d, age at first kidding 396.32 d, kidding interval 199.66 d and postpartum estrus interval 39.06 d. The service per conception and litter size were 1.33 and 2.84, respectively. The average birth weight and weaning weight of the kids were 1.09 kg and 4.4 kg for the male, 1.04 kg and 4.36 kg for the female, respectively (Table 1).

3.4. *Disease prevalence*

The most prevalent disease was parasitic infestation followed by nutritional deficiency, PPR, keratoconjunctivitis, acidosis and fibrous osteodystrophy (Figure 1).

3.5. *Kid mortality*

The average mortality of the BBG kids was 0.78% in the study area (Table 1).

3.6. *Determinant of mature weight*

The main determinants (P<0.05) of the mature body weight of black Bengal goat were birth weight of male goat, type of concentrate feed provided, height of goat house, width of goat house, deworming practices, owner's exposure to training, additional feeding of pregnant dam, horn pattern, rearing system, weaning weight of male kid, kidding interval, age at first kidding and amount of roughage supply.

Table 1. Overall least squared means of the performance parameter of Black Bengal goat reared under semi-intensive system (N=404)

Parameter	Mean	SE	95% CI	
			Lower	Upper
Mature body weight (kg)	22.92	0.370	22.18	23.66
Daily milk yield (kg)	0.50	0.011	0.48	0.52
Body condition score of the dam	3.44	0.095	3.25	3.63
Birth weight of the male kid (kg)	1.09	0.054	0.98	1.19
Birth weight of the female kid (kg)	1.04	0.042	0.96	1.12
Weaning weight of the male kid (kg)	4.40	0.212	3.97	4.82
Weaning weight of the female kid (kg)	4.36	0.164	4.03	4.69
Age at first service (day)	220.14	3.878	212.35	227.93
Service per conception (no)	1.33	0.023	1.28	1.38
Age at first kidding (day)	369.32	5.676	357.91	380.73
Kidding interval (day)	199.66	2.813	194.01	205.31
Postpartum estrus interval (day)	39.06	0.716	37.62	40.50
Litter size (no)	2.84	0.087	2.66	3.02
Herd size (no)	8.08	0.435	7.21	8.95
Male to female ratio	0.41	0.039	0.33	0.49
Concentrate supply (g/day)	366.00	7.205	351.52	380.48
Roughage supply (g/day)	2.38	0.091	2.20	2.56
Concentrate for pregnant dam (g/day)	396.00	5.686	384.57	407.43
Length of the goat house (m)	8.20	0.149	7.90	8.50
Height of the goat house (m)	7.13	0.138	6.85	7.41
Width of the goat house (m)	6.17	0.148	5.87	6.47
Kid mortality (%)	0.78	0.059	0.66	0.90
Farming experience (year)	4.95	0.310	4.33	5.57

Table 2. Genetic, nutritional and environmental determinants of the mature body weight of Black Bengal goat reared under semi-intensive system (N=404)

Determinants	Slope (β)	SE	Z	95% CI		P-value
				Lower	Upper	
Birth weight of male kid	5.79	1.43	4.05	2.99	8.60	0.000
Type of concentrate feed	0.63	0.12	5.17	0.39	0.87	0.000
Height of goat house	-5.81	1.44	-4.03	-8.63	-2.98	0.000
Width of goat house	3.52	0.78	4.51	1.99	5.05	0.000
Deworming practices	3.31	0.78	4.25	1.78	4.84	0.000
Owner exposure to training	2.62	0.72	3.66	1.22	4.03	0.000
Feeding for pregnant dam	0.04	0.01	3.33	0.02	0.06	0.001
Horn pattern	-2.57	0.82	-3.15	-4.17	-0.97	0.002
Rearing system	6.68	2.32	2.88	2.14	11.22	0.004
Weaning weight of male kid	2.17	0.92	2.36	0.36	3.98	0.018
Kidding interval	0.05	0.02	2.35	0.01	0.09	0.019
Age at first kidding	0.02	0.01	2.31	0.00	0.04	0.021
Amount of roughage supply	1.32	0.63	2.11	0.09	2.55	0.035
Sex of the farm owner	-2.09	1.04	-2.02	-4.12	-0.06	0.043
Coat color of goat	2.05	1.02	2.02	0.06	4.05	0.044
Location of the goat house	-1.17	0.61	-1.92	-2.37	0.02	0.055
Floor type	-0.48	0.25	-1.91	-0.98	0.01	0.056
Owner's educational qualification	0.28	0.15	1.91	-0.01	0.57	0.057
Herd size	-0.22	0.12	-1.89	-0.44	0.01	0.059
Ratio of male to female goat	-2.41	1.34	-1.79	-5.04	0.23	0.073
Birth weight of male kid	6.22	3.48	-1.79	-13.04	0.60	0.074
Amount of concentrate supply	0.02	0.01	-1.77	-0.03	0.00	0.077
Feeding system practiced	1.27	0.81	1.58	-0.31	2.86	0.115
Type of housing provided	-1.10	0.72	-1.53	-2.52	0.31	0.127
Body condition score of the dam	0.93	0.63	1.47	-0.31	2.17	0.141
Length of goat house	1.37	1.03	1.33	-0.64	3.39	0.182
Type of roughage provided	-0.90	0.78	-1.16	-2.42	0.62	0.245
Service per conception	2.68	2.79	0.96	-2.78	8.13	0.337
Dam's milk yield	5.38	5.88	-0.92	-16.89	6.14	0.360

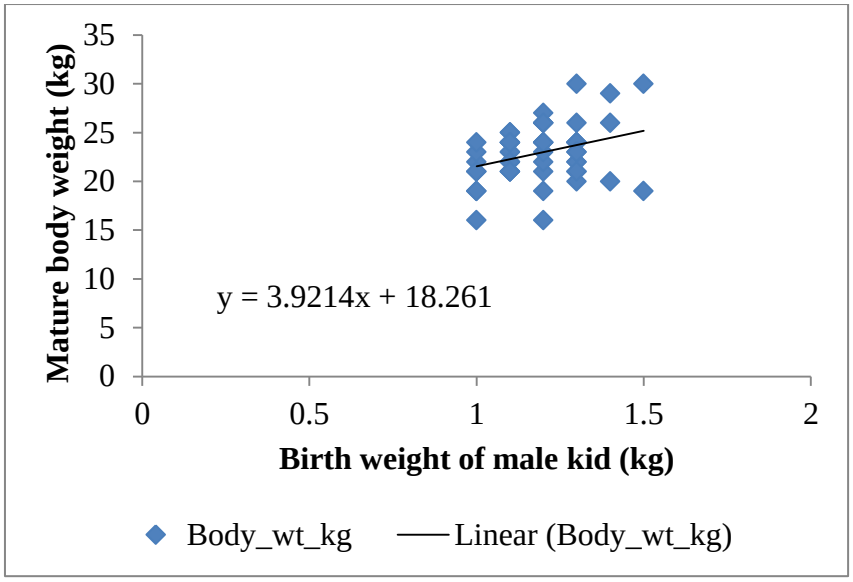

Figure 1. Association between birth weight of male kid and mature body weight of Black Bengal goat (N=404)

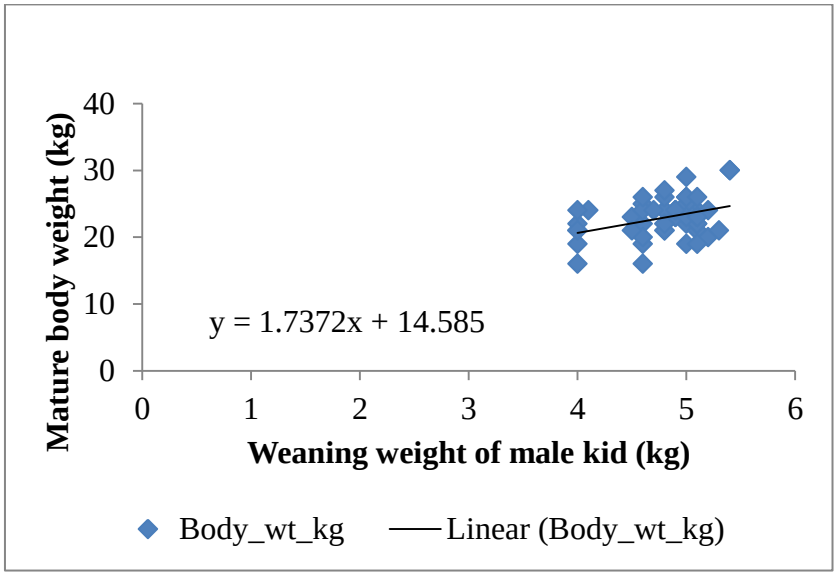

Figure 2. Association between weaning weight of male kid and mature body weight of Black Bengal goat (N=404)

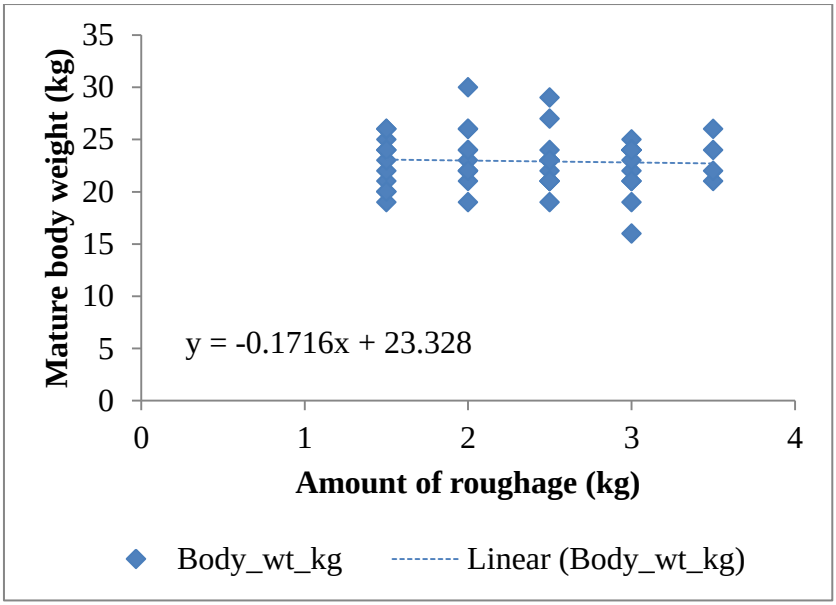

Figure 3. Association between roughage supply and mature body weight of Black Bengal goat (N=404)

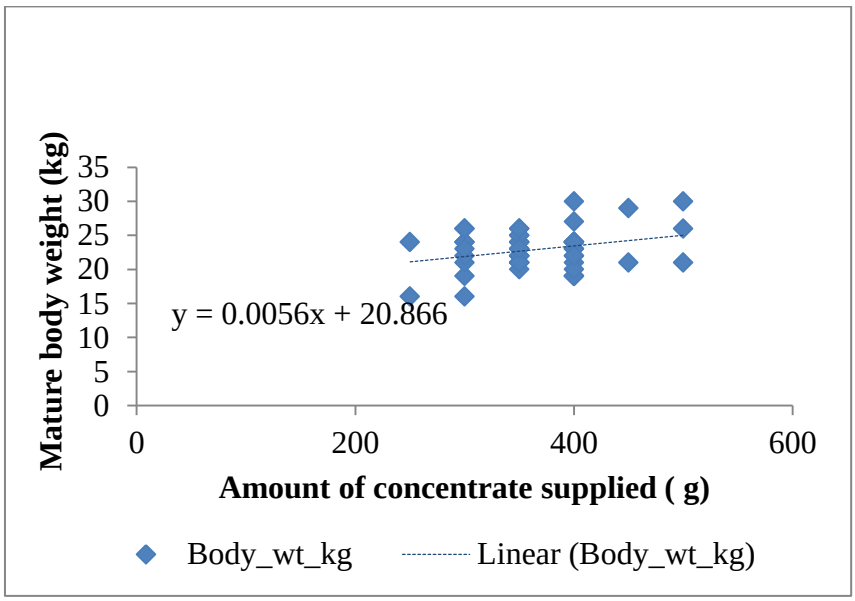

Figure 4. Association between concentrate supply and mature body weight of Black Bengal goat (N=404)

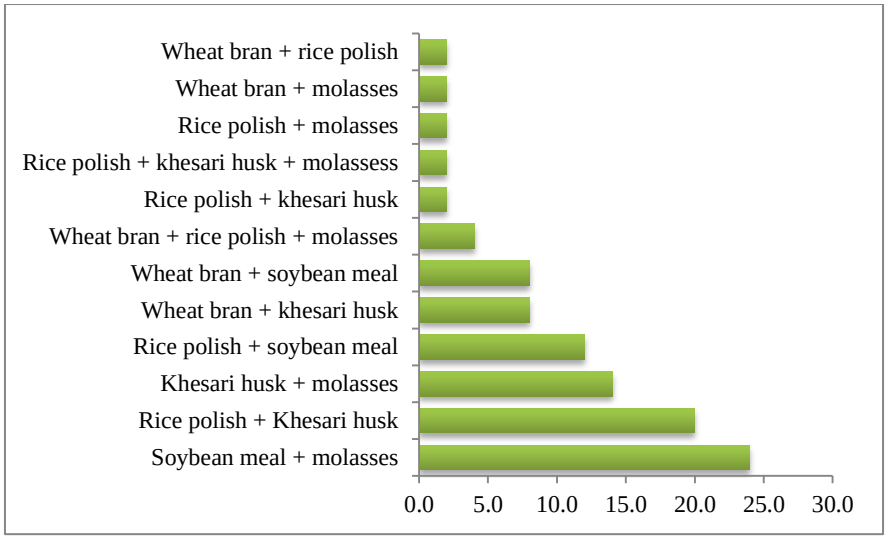

Figure 5. Existing feeding practices of the Black Bengal goat (N=404)

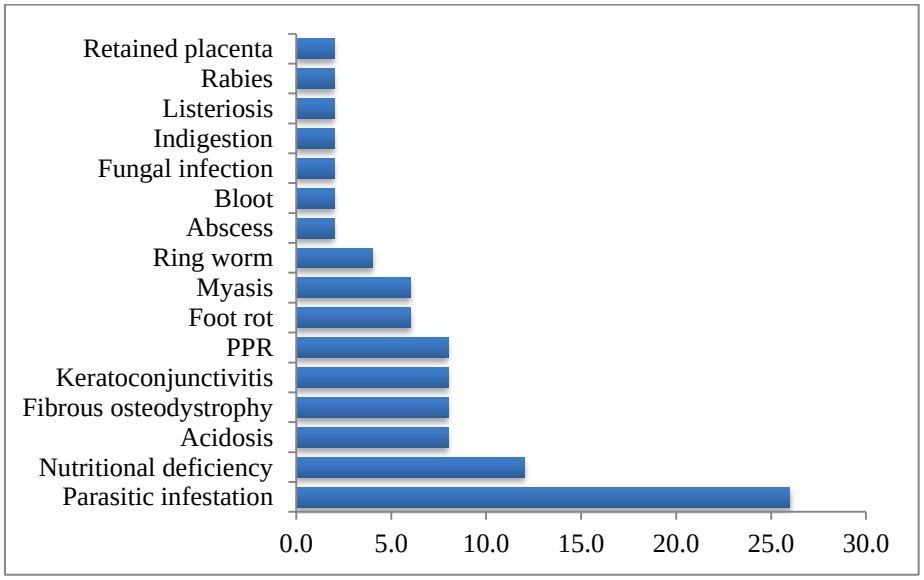

Figure 6. Disease prevalence of the Black Bengal goat (N=404)

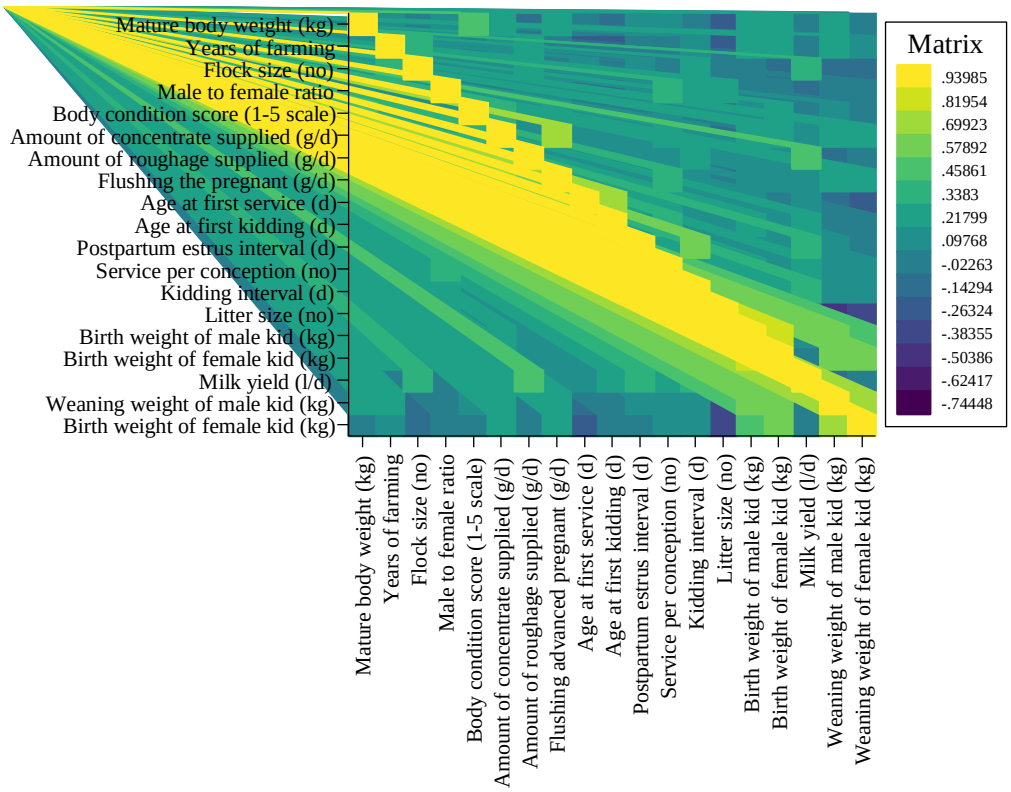

Figure 7. Orthogonal contrasts of the determinants of mature body weight of Black Bengal goat (N=404)

Chapter IV: Discussion

4.1. *Herd structure*

The average herd size of the Black Bengal goat (BBG) in the study area under semi-intensive system was 8.1 which implies that the rural households used to rear small goat herd as a part of their integrated subsistence farming system. Another results were reported by (Shoshe et al., 2019) who found maximum (61%) farmers have more than 10 goat in semi-intensive system. Dissimilar results were reported by (Hasan et al., 2014) who found one to four herd size in most cases. The male to female ratio of the herd was 0.41 which indicates that the herds were dominated by the female goats compared with their male counterparts. The male to female ratio in the previous studies in were 1.03 (Majumder et al., 2017), 1:1 (Nandi et al., 2011)

4.2. *Housing system*

The housing systems for goats depend mainly on the socio-economic condition of the farmer and rearing systems of the goats. In the rural areas the most of the goats are reared by the landless farmers and unemployed women who hardly have capacity enough to provide organized separate housing for their goat. Instead they rear their goats either in a part of their living house or in a corner of their kitchen. For medium scale semi-intensive farming, the farmers usually provide a tin-shed, bamboo and wood supported earthen floor goat house with facilities for night shelter and hardly additional concentrate (Akhtar et al., 2021) However, the large scale intensive and semi-intensive farm houses are brick-cemented with concrete floor having feeding, watering, kidding and isolation facilities necessary for goat. These types of housing are mostly present in different government farms, research institute, universities and also in some commercial goat farms (Bari et al., 2020).

4.3. *Feeding system*

The farmers used to supply 366.0 g of concentrate and 1038.0 g of roughage per day for the adult male and 396.0 g of concentrate for the pregnant dam in the study areas. Under semi-intensive feeding system the goats are usually grazed on harvested or fallow land, roadsides,

river banks and canal slopes. A variety of feeds are available throughout the tropics and sub-tropics. The most common type of pasture available in the study areas were roadside grass, e.g., dubra (*Cynodon ductylon*), ghora (*Cryptocoryne retonspirales*), chapra (*Eleusine indica*), guinea (*Megathyrsus maximus*), para (*Brachiaria mutica*), napier (*Pennisetum purpureum*) and varieties of trees leaves, i.e., jackfruit (*Artocarpus heterophyllus*), jhika (*Lannea coromandelica*), mango (*Mangifera indica*), jam (*Acacia acuminate*), boroi (*Zizphus manuritiana*), lychee (*Litchi chinensis*), guava (*Psidium guajava*), ipil-ipil (*Leucaena leucocephala*) and krishnachura (*Dolonix regia*). Concentrate mixture consisted of wheat bran, rice polish, khesari husk, soybean meal, molasses and common salt which were prepared manually. The mixture contained approximately 10-12 MJME/kg DM and 17% CP. Green grass was supplied as per requirements with free access of drinking water. Concentrates were offered twice daily (morning and evening) according to the age of the animal (Hossain, 2021; Samad, 2021).

4.4. *Productive performance*

The mature body weight of BBG obtained in the current study was 22.92 kg. Similar results were reported in previous studies where mature body weight were 17.17±3.25 kg (Mohammad et al., 2020), 27.5±6.9 kg (Ahmed et al., 2021). Dissimilar results were reported in previous studies where mature body weight were 15.4±0.65 kg (Solaiman et al., 2020) and 12.4 kg (Asad et al., 2020). Accordingly, the daily milk yield of the BBG obtained in the current study was 0.5 kg/d. Similar results were reported in previous studies where milk production were 275.00±13.04 ml/d (Chanda et al., 2020), 304.2±14.4 ml/d (Mohammad et al., 2020), 287.7 ml/d (Jalil et al., 2016), 346.2±74.9 ml/d (Mia et al., 2018), 227.2±33.0 g/d (Faruque et al., 2010), 158.8±40.5 ml/day (Bhowmik et al., 2014), 214 + 0.01ml/d (Islam et al., 1970). Differences in body weight within breed are influenced partly by genetic factors but largely variation due to environmental factors (Amy et al., 2019). Variation in body weight may be due to availability of feeds and fodder and other management (Paul et al., 2014). Basically nutrition, management and health are the most influencing factor in mature body weight that's reported in my present study. The milk yield of BBG may vary due to differences in the feeding system, age of dam, health condition and overall management practices (Samad, 2021). Milk producing ability is mainly controlled by genetic properties within and between the breeds but environmental factors also affects the total milk yield

(Samad, 2021). The variation of milk yield might be due to differences in feeding and management practices by the moderate and ultra-poor households (Halim et al., 2011).

4.5. *Reproductive performance*

4.5.1. Age at the first service

The age at the first service of BBG obtained in the current study was 220.1 d. similar results were reported in previous studies where age at the first service of BBG of three upazilas Birganj, Sadar and Birol at Dinajpur district were 8.3±0.69, 8.0±0.86 and 7.0±0.43 months, respectively (Islam et al., 2020). The result, however, differs with Mohammad et al., 2020 (163.6±17.7 d), Mia et al., 2018 (196.5± 5.5 d), Chowdhury et al., 2001 (10.98±0.57 m) and , Hasan et al., 2014 (197.82±12.58 d). Age at the first services varies due to age of the puberty, presence of buck in the herd and nutrition (Samad, 2021). In my present study we identified that heat detection, availability of buck and social behavior may influence the age at the first service in the semi-intensive system.

4.5.2. Service per conception

The service per conception (SPC) of BBG obtained in the current study was 1.33. The SPC is frequently used as an indicator of fertility of an individual. The lower the SPC, the higher is the reproductive efficiency. The SPC obtained in the present study closely resembles the results reported in previous studies where the average SPC were 1.46±0.53 (Mohammad et al., 2020) , 1.17±0.04 (Solaiman et al., 2020), 1.17±0.46 (Mia et al., 2018), 1.2±0.23 (Faruque et al., 2010) and 1.45 (Chowdhury et al., 2001). Differences in number of services per conception between breeds may be due to lack of proper detection of estrus and methods used for insemination (Chanda et al., 2020). The number of services per conception was significantly varied with coat color. Number of services per conception was lower in solid black i.e. The reproductive performance is better in solid black coated goat than white, Black with Dutch belt spotting and Brown bezoar coat color goats (Mia et al., 2018). Service per conception not affected by the feeding level and parity (Halim et al., 2011). Lots of non-genetic factors are responsible for SPC like mating system, heat detection, time of

insemination, reproductive disturbance of does, semen quality of buck which may interfere sound conception leading to variation among population (Afroz et al., 2020)

4.5.3. Kidding interval

The kidding interval of BBG obtained in the current study was 199.1 d. Similar results were reported in previous studies where the kidding intervals were 190.2±0.20 d (J. Hasan et al., 2014), 187.1±1.09 d (Solaiman et al., 2020), 185 d (Chowdhury et al., 2001), 183.2±11.8 d (Mia and Mondal, 2020). Dissimilar results were reported in previous studies where the kidding interval were 252.45±3.57 d (Halim et al., 2011) , 177.0±7.4 d (Chanda et al., 2020), 179±20 d (Hassan et al., 2007). Kidding interval varies due to proper physiological function of organs and glands involved in hormonal surge for onset of estrous and ovulation with advancement of age (Halim et al., 2011).These differences could have been due to the effect of different management practices, insufficient feed supply, lactation length and genetic makeup of goats on possibilities to prompt re-conception after parturition (Hossain, 2021; Samad, 2021).Kidding interval may be deviated due to difference of management, plain of nutrition, seasonality of reproduction or repeat breeding occurrence (Afroz et al., 2020).

4.5.4. Postpartum estrus interval

The postpartum estrus interval (PEI) of BBG obtained in the current study was 39.1 d. Similar results were reported in previous studies where the PEIs were 31.9±6.56 d (Mia et al., 2018), 38.8±10.5 d (Hassan et al., 2007), 33.1±5.4 d (Faruque et al., 2010), 47.5±0.87 d (Solaiman et al., 2020). Dissimilar results were reported in previous studies where the PEIs were 67.00±4.97 d (Halim et al., 2011), 3.08±0.53, 3.92±0.50 and 2.67±0.40 m in three upazilas Birganj, Sadar and Birol at Dinajpur district (Islam et al., 2020). Apart from genetics, several factors can influence the length of the post-partum heat period, including uterine involution, short cycling, suckling effects, and nutritional status, season of parturition (Samad, 2021). Many factors like feeding, nutrition, housing, reproductive management, improper heat detection, reproductive disorders and others may be associated with the variation of PEI in the small ruminant animals (Moni and Samad, 2019). The better management and nutrition seem to be the most important contributing factors responsible for shortening the PEI in the BB goat (Halim et al., 2011).

4.5.5. Litter size

The litter size of BBG obtained in the current study was 2.84. Similar results were reported in previous studies where the litter sizes were 2.00±0.00 (Islam et al., 2009), 1.96± 0.75 (Hassan et al., 2020), 1.92±0.90 (Chanda et al., 2020). Dissimilar results were reported in previous studies where the litter sizes were 1.76±0.08 (Solaiman et al., 2020), 1.06±0.13 (Hasan et al., 2014), 1.06±0.13 (Faruque et al., 2010) and. Litter size is considered as one of the major criteria to evaluate the ability of goat prolificacy which is influenced by both genetic and environmental factors (Solaiman et al., 2020). Litter size may be affected by parity, age, genetic and environmental factors, and also by buck used for service (Moni and Samad, 2019). Litter size was affected by nutrient level, body weight parity, age and genetic factors (Hasan et al., 2015)

4.5.6 Birth weight of kids

The average birth weight of the kid of BBG obtained in the current study was 1.09 kg for male and 1.04 kg for female. Similar results were reported in previous study where the birth weights of the kid of BBG were 1.10±0.21 kg (Chanda et al., 2020). The birth weight of BBG in another study at the 1^{st}, 2^{nd} and 3^{rd} parities were 0.92±0.01, 0.99±0.01 and 0.97±0.01 kg, respectively (Amy et al., 2019). Accordingly, in another study the mean values were 1.28 ± 0.11 kg (Faruque et al., 2010), 0.89±0.09 kg (Bhowmik et al., 2014) and 1.30 + 0.03 kg (Islam et al., 1970). Dissimilar results were reported in previous study where the birth weights of the kid of BBG were 1.60±.50 kg (Hassan et al., 2020), 1.57±0.10kg (J. Hasan et al., 2014).The lower body weight at birth of BBG due to extensive management system, poor feeding, disease and poor breeding management. Environmental factors also responsible for poor body weight at birth (Amy et al., 2019). Birth weight of kids gradually decreased with the increase of litter size. So, there was a negative correlation between birth weight and litter size. Birth weight of kids decreased with increase of herd size due to lack of proper management and feeding practices at rural level (Halim et al., 2011).

4.5.7 Weaning weight of kids

The average weaning weight of the kids of BBG obtained in the current study were 4.40 kg for male and 4.36 kg for female. Similar results were reported in previous study where the weaning weight of the kids of BBG were 4.96±0.15 kg (Shoshe et al., 2019). Dissimilar results were reported in previous study where the weaning weight of the kids of BBG were 5.43 kg (Amy et al., 2019) and 5.43±0.05 kg (Islam et al., 1970). The weaning weight of the kids depends on plane of nutrition, diseases condition and management. The weaning weight depends on adequate supply of nutrition and low weaning weight is mainly due to malnutrition, poor hygienic management and inadequate health status of doe. The weaning Weight falls with the increase in number of goats in a herd of both moderate and ultra-poor households (Halim et al., 2011). The lower weaning weight found at winter season due to disease, lacking of feed and management systems (Amy et al., 2019).

4.6. Disease prevalence

The most prevalent diseases of BBG obtained in the current study were parasitic infestation followed by nutritional deficiency, PPR, keratoconjunctivitis, acidosis and fibrous osteodystrophy. Similar results were reported in previous study where diseases prevalence were diarrhea (19.9%), anorexia (19.9%), pneumonia (13.8%), bloat (11.2%), contagious ecthyma (11.2%), mixed parasitic infestation (8.7%), corneal opacity (3.0%), anuria (3.0%), mange (2.6%), anestrus (2.0%), abscess (1.5%), abortion (1.5%) and retention of placenta (1.5%) (Mohammad et al., 2020), diarrhea (13.79%) and contagious ecthyma (13.79%), PPR(23.08%) (Kashem et al., 2011), parasitic infestation (63.41%) (Hassan et al., 2011).The disease occurrence may vary according to age, sex and season. This variation may be due to different management practice, nutrient supplementation, and vaccination, deworming and rearing system. Lack of proper care and overall poor husbandry practices are also responsible for disease prevalence. Black Bengal Goats have natural resistant power to many diseases but are vulnerable to cold, water logging situation, diarrhea, ecto and endo parasitic infestation and respiratory diseases (Nandi et al., 2011). Black Bengal goat is vulnerable to rain water and water logging conditions. This breed is usually not suffered from major disease problem for their high disease resistance capacity. Incidence of various clinical manifestations like pneumonia, fever, diarrhea, ectoparasitic infestation, pox, anorexia, alopecia is common in this breed (Shoshe et al., 2019).

4.7. *Kid mortality*

The kid mortality of BBG under semi-intensive system was 0.78% in the current study. In the study kid mortality is lower due to proper nutrition supplement, better management and deworming practices. Dissimilar results were reported in previous studies where overall kid mortality was 8.12% (Moni and Samad, 2019),8.0% (Samad, 2021), 15.0±0.50% (Hasan et al., 2014). In fact, kid mortality is influenced by weight of doe, parity, birth weight, milk yield, season, feeding, housing and disease (Paul et al., 2014). Nutritional deficiency cause relatively low birth weight, slow growth rate and insufficient milk production to increase higher kid mortality. The better environment especially nutrition and health which would have positive effect on total weaned kid production by reducing the kid morbidity and mortality and increasing the kid growth rate (Samad, 2021).

Chapter V: Conclusion

Birth weight of male goat, type of concentrate feed provided, height of goat house, width of goat house, deworming practices, owner's exposure to training, additional feeding of pregnant dam, horn pattern, rearing system, weaning weight of male kid, kidding interval, age at first kidding and amount of roughage supply determine the mature body weight of Black Bengal goat.

Chapter VI: Reference

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Appendix-I

A questionnaire on Determinants of the mature body weight of Black Bengal goat under semi-intensive systems of rearing in Rangpur Sadar, Rangpur.

General Information of Farm and Farmer:

1. Name of the farm:
2. Farmer's name:
3. Educational qualification:
4. Sex of farmer:
5. Years of farming:
6. Cause of farming:
7. Any training received on farming:
8. Contact Number:

Physiological Data:

1. Species: Goat
2. Breed: Black Bengal
3. Sex: Male/Female
4. Flock size:……..
5. Ratio of Male and Female:…….. : ……..
6. Age: ……
7. Horn Pattern: Horned / polled
8. Body condition Score: 1 / 2 / 3 / 4 / 5
9. Body Weight: …….
10. Physiological status:……
11. Color: Solid black / Black with toggenburg pattern / Black with Dutch belt spotting / other combination

Housing Data:

1. Rearing system: Confinement/Semi intensive
2. Housing type: kacha / Brick walled house / others
3. Floor: Earthen type / Brick finished / Cemented floor / Macha type
4. Housing Location: Attached with residence / Separate
5. Area of house: Length……. Height…….. Width……..

Feeding Data:

1. Feeding system: Tethering / Intensive / semi-intensive
2. Feed ingredients: Concentrate / Concentrate and green grass
3. Amount of Feed: Concentrate:…… Roughage:……
4. Type of Roughage: Grass / Tree leaves
5. Name of the roughage:
6. Name of the concentrate:
7. Grazing: Grazing from morning to noon/ grazing separately in morning and afternoon
8. Grazing during rainy season: yes / no
9. Tethering: Adoption of tethering grazing / Grazing without tethering
10. Feeding during rainy season: Tree leaves / Grass
11. Amount of feed supply in pregnant period:……
12. Type of feed supply in pregnant period:……
13. Source of water: pond water /well water / Tube well water
14. Amount of water supply:……

Reproduction Data:

1. Breeding policy: Natural mating / Artificial Insemination
2. Age at first service:…….
3. Age at first kidding:……
4. Postpartum estrus interval(days):……
5. Service per conception:……
6. Kidding interval:……
7. Litter size :……..
8. Birth weight: Male kids:
   Female kids:
9. Amount of Milk production:…….
10. Weaning weight: Male kids:
    Female kids:
11. Kid mortality up weaning:

Clinical Data:

1. Vaccination: Yes / No
2. If yes, Name of the Vaccine:
3. Regular Deworming: Yes / No
4. Type of Diseases: Bacterial / Viral/ Nutritional/ Others

5. Sign of Diseases:……..

6. Age in disease period:

6. Tentative diagnosis:

7. Treatment of the diseases:

#Additional Findings:

Acknowledgement

The author bends his heads to the Almighty who is omnipotent, omniscient and omnipresent for His endless blessing to conduct this research work for the fulfillment of the requirement for the degree of Doctor of Veterinary Medicine (DVM).The author desires to express his earnest gratefulness and profound appreciation to the following persons for the accomplishment of this dissertation.

The author gratefully expresses his heartfelt indebtedness deepest sense of gratitude, sincere appreciation and profound respect to his honorable supervisor **Prof. Md. Emran Hossain**, Department of Animal Science and Nutrition , Chattogram Veterinary and Animal Sciences University for his scholastic guidance, inspiration affectionate feeling, encouragement in all phases of this study and preparing the manuscript.

The author would like to express his deep sense of gratitude and thanks to **Prof. Dr.Mohammad Alamgir Hossain**, Dean, Faculty of Veterinary Medicine, Chattogram Veterinary and Animal Sciences University for arranging this type of work as compulsory part of the internship program.

The author would like to express his deep sense of gratitude and heartfelt appreciation to **Prof. Dr. A. K. M. Saifuddin**, Director, External Affairs, Chattogram Veterinary and Animal Sciences University for the provision of this unique internship program and research exposure.

The author is ever indebted to his parent, brothers, sisters, friends and other relatives for their sacrifices, blessing and encouragement to get him in this position.

Biography

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